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Attorney for Plaintiff

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

ROBERT J. KRAUS and MARGARET M. KRAUS, h/w	: CIVIL ACTION :
vs.	:NO. 18-CV-2119
ALCATEL-LUCENT, et al.	:ASBESTOS CASE

ANSWER TO MOTION FOR SUMMARY JUDGMENT OF CBS

CBS has not met its burden. Its motion should be denied.

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PLAINTIFF'S ENUMERATED COUNTER STATEMENT OF DISPUTED FACTS TO CBS STATEMENT OF CLAIMED UNDISPUTED FACTS

1. Admitted. However his actual title was electronic material officer (EMO).

2. Admitted in part, denied in part. In addition to CBS' assertions he was present when sailors performed work on electronic equipment near him. This included opening equipment on a monthly basis as part of preventive maintenance. In that opening dust was emitted from every piece of fraying and deteriorated equipment inside the CBS products and the products of others. The dust was so great it had to be vacuumed out. Kraus inhaled dust from this activity (Exhibit A, Kraus 25-30, 180-185)(Exhibit B, Gossett 49-54, 60-67).

3. Admitted in part, denied in part. He was present everyday when all work was done (Exhibit B, 91). What is relevant is that all the equipment contained asbestos (Exhibit E). Every month every piece of equipment was opened. Every piece of equipment contained

asbestos. Every time the equipment was opened frayed asbestos was released into the air plaintiff breathed (Exhibit B, 73). Westinghouse products were among those which emitted the asbestos (Exhibit E, R).

4. Denied. Westinghouse equipment was in the shop. All the equipment including Westinghouse's was opened. All the equipment emitted asbestos plaintiff installed (Exhibit B, 60). Westinghouse admits that asbestos wire, cable and tape emit asbestos fibers when handled or machined (Exhibit F).

5. Denied. Westinghouse is the sole identified supplier of the following equipment: WRT-1A, WRT-2 and the, TED 1, 3, 5, 7 (Exhibit D).

6. Denied in part, admitted in part. The testimony is that he was near the SPS-40 while it was worked on. In any event, he was near the WRT-1A & WRT-2 when they were worked on (see above).

7. Denied.

8. Admitted only that the military specifications required warnings which Westinghouse despite its knowledge of the hazards of asbestos chose not to provide (Exhibit H&I).

9. Admitted that Westinghouse helped design the military specifications so it knew of the duty to warn.

10. Denied. The Navy required warnings but Westinghouse did not follow Navy requirements including military specifications since to 1936. Mere passive approval of Westinghouse's negligence is not enough to protect Westinghouse, see *Willis v. BW/IP*, 811 F.Supp.2d 1146.

11-12. Denied. Westinghouse was required to warn of the hazards of asbestos and failed to warn (Exhibit H&I).

13-14. Denied. The Navy mandated warnings (Exhibit H&I).

15. Denied. Navy's knowledge and activities are irrelevant. In any event it is not clear Navy knew about asbestos and cancer. Based on Westinghouse's own expert admits Navy did not know or concern itself with asbestos (Exhibit K). Its Westhinghouse's 1948 Safe Practice sheet shows it knew now.

16-20. Denied. The defendant is left to its proof. Navy's conduct in World War II is irrelevant (also see answer 15).

21-22. Denied. This is for defendant to prove and is irrelevant.

23. Westinghouse knew that asbestos was hazardous not later than 1948 when it published for internal use only Safe Practice Data Sheets A-20 but could have known earlier from its membership in the National Safety Council, The Industrial Hygiene Foundation Scientific literature or from its rival and partner General Electric and the Commonwealth of Pennsylvania.

24. Westinghouse continued to discuss hazards of asbestos for internal use only when it continued to refuse to disclose what it knew to users (Safe Practice Data Sheet F).

25. Westinghouse, as a member of the American Industrial Hygiene Foundation knew asbestos was hazardous since the 1930's (Exhibit F).

26. Westinghouse, as a Pennsylvania employer knew it was required to carry insurance for asbestosis for its workers since 1939 so it should have known and warned of the hazards. Court can take judicial notice thus was the year asbestos was a workers compensatoin

claim.

27. Westinghouse as a Pennsylvania employer received issuances of the state of Pennsylvania particularly asbestos dust being dangerous during manufacture of asbestos by its rival and occasional partner GE.

28. Westinghouse could have known what GE knew in the 1930's i.e. asbestos was hazardous and admitted it in *Beasejour* discovery answers.

29. Westinghouse admits handling of asbestos wire, cable, tape and paper releases dangerous levels of asbestos (Exhibit F).

30. Westinghouse's WRT-1A&2 contained asbestos because it was an electronic product and the standards of the time required asbestos (Exhibit E).

31. Plaintiff was exposed to asbestos dust from Westinghouse's WRT-1&2.

32. Westinghouse has no evidence to show that the WRT-1 & WRT-2 did not contain asbestos.

33. Westinghouse admits its made or used or distributed asbestos containing tape, wire, cable, paper, board and cloth for resistors and other products that it knew were dangerous.

34. Westinghouse was obliged and agreed to comply with 1936 S-1 and Military Specifications 15071;15071A-E thereafter and Secretary of the Navy issuances (Exhibit H).

35. These specifications required warnings of hazards.

36. The Navy required Westinghouse to warn of hazards (Exhibits H & I).

37. Despite mere speculation from its experts, Westinghouse cannot show an instance where it was barred from warning of the hazards of asbestos.

38. Westinghouse warned of other hazards such as exposure to high heat or electricity

without the Navy barring such warnings.

39. Westinghouse fully expected or directed monthly preventive maintenance on the WRT-1 and 2 in which the WRT 1 would be opened.

40. Westinghouse knew that the interior asbestos products in the WRT-1 would fray and release dust that would be inhaled by workers and bystanders.

41. Westinghouse supplied replacement asbestos to the Navy for ships such as the Cambria.

42. Westinghouse employees supervised maintenance and repair of the WRT-1 at the Philadelphia Navy yard.

43. Kraus was the officer in charge of electronic shop on the Cambria for about 3 years.

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ANSWER AND MEMORANDUM OF CBS MOTION FOR SUMMARY JUDGMENT

I. OVERVIEW

Westinghouse, VIACOM & CBS are one entity and reference to one is a reference to all. Because CBS is the present entity but the relevant activities occurred during the Westinghouse days[1] generally Westinghouse will be referred to in this memorandum. Although many of the averments apply to CBS as well.

COUNTER STATEMENT OF DISPUTED FACTS

The relevant facts are as follows:

1) Westinghouse/CBS admits it was part of an organization that received articles on asbestos as a hazard since the 1930's (Exhibit G) answers to discovery in Harris

[1] The entity presently known as Westinghouse is not the defendant involved in this case. Further, CBS also provided asbestos products, but the names Westinghouse and CBS will be used interchangeably to the ship.

County Texas. It admitted knowing of the hazards since the 1940's (Exhibit G) and actually wrote internal memos on the hazards of asbestos, see Safe Practice Data Sheet (Exhibit F), sold its WRT-1A&2 and TED-1, 3, 5, 7, 9 to the Navy for use on the USS Cambria without warning of the hazards of asbestos despite the navy's requirements of warnings (Exhibits H & I).

2) The archive records show presence of WRT 1&2 and TED 1, 3, 5, 7, 9 on the Cambria in 1964-1967 (Exhibit C).

3) All are radio/radar/electronic pieces of equipment and therefore were located and repaired in the electronic shop of the ship.

4) These pieces contained resistors and capacitors.

5) The standard composition of resistors and capacitors of the time included asbestos.

6) All the electronic equipment was opened regularly once a month for preventive maintenance purposes.

7) When that opening occurred dust was released which flew into the air to mix with asbestos dust from other products to be inhaled by Kraus regularly and frequently over his three years on the ship.

8) The Navy required warnings of possible hazards since the 1930's which Westinghouse admits it never gave. The law to be applied in both Pennsylvania and maritime.

9) Westinghouse sold asbestos condensers tubes, heating coils, micarta, tape, paper, wire wound assemblies.

10) Westinghouse distributed asbestos-containing wire.

11) The archives records show Westinghouse's WRT-1A and 2 and CBS TED

1, 3, 5, 7 on the Cambria and wire.

12) Westinghouse admits that paper and tape release unacceptable levels of asbestos.

13) Westinghouse has known asbestos release from asbestos paper and asbestos tape release dangerous levels of dust since the 1940's.

14) Co-worker Gossett testified that work was constantly being performed on WRT-1 and TED.

15) The Navy did not know as much as Westinghouse.

16) The Navy required warnings which Westinghouse & CBS refused to give.

Kraus served as an electronic materials officer (EMO) on the USS Cambria. As an EMO he was responsible for every piece of equipment in the electronic shop (Exhibit A, NT 25-27). He was responsible for keeping track of the equipment including periodic maintenance of the equipment (28). There waw constant repair to the equipment (27). Every piece of equipment had to be opened and cleaned in the ship (30, 181-186) because they collected dust from initial parts. There were heat insulating pads in the radios. The shop was cluttered and crowded and he was next to all equipment. The technicians he supervised wouldn't touch or be near all equipment but he views his job to be near that equipment (181). This included vacuuming out the dust (83) which he inhaled. His job was to be near every piece of electronic equipment on the ship (206).

His testimony was confirmed by the chief petty officer, Gossett. In his deposition Gossett testified every piece of electronic equipment contained resistors and capacitors (Exhibit B, 49,53, 54). He testified that every piece of equipment on the ship was taken to the shop and was opened

once a month and vacuumed out because (Exhibit B, 60) the equipment turned to dust inside the boxes (65-67). Internal dust was generated by the high temperature products (67). Resistors would get frayed (73). The technicians had to check for and replace frayed parts (73). The plugged in units required regular change (73). They used asbestos when soldering parts (79). Kraus was in the shop frequently (91-92). The antennas had to be cleaned out every three months (95). All this electronic equipment including the WRT 1&2 (40, 62, 135) and TED (40, 62) contained boards, connectors capacitors, resistors and sockets (72). Records from the National Archives show the following Westinghouse products on the ship VK-5 repeaters, WRT-1&2 and TED 3&7 (Exhibit C). These are confirmed to be Westinghouse or CBS products by other documents (Exhibit D).

Gossett recalled the WRT-1 transmitter and mots transmitters and receivers were high temperature uses (Exhibit B, 67, 135). Navy documents and pictures of the products confirm that Westinghouse (WRT 1&2) or CBS itself (TED) supplied this equipment for use on the ship see (Exhibit D). Thus, with at least 6 pieces of equipment in the shop opened 12 times a year multiply by three years he was exposed to dust released in the small area of the shop from Westinghouse equipment over 216 times. The Westinghouse/CBS products at issue contained asbestos as the patents, articles, and National Bureau of Standards materials and the Navy documents make clear including GE's resistors containing asbestos-containing electronic tubes and electrobestos (Exhibit E). Bell in 1960 referenced "old-style" resistors as containing asbestos which makes sense in light of GE's patenting the technology in 1935 that the state of the art was that all resistors contained asbestos (Exhibit E). The Navy noted in the 1980's that asbestos was in resistors for electronic equipment on ships (Exhibit E). Westinghouse itself

conceded in 1948 that handling asbestos tape, cloth and paper the primary asbestos products in resistors releases dangerous levels of asbestos dust (Exhibit F). GE also admitted wire gives off dangerous levels of dust (Exhibit F) so Westinghouse knew, should or could have known. Westinghouse admits has known at least since the 1930's of the hazards of asbestos in its products (Exhibits F & G). Through its membership in the American Hygiene Foundation and its own obligations to keep a breast of literature Westinghouse admits it was able to learn of the numerous articles on the hazards of asbestos (Exhibit H) including those discussed by Dr. Frank (Exhibit J). Interesting however, that while Westinghouse admits it knew of the hazards and told its our employees of the hazards (Exhibit F) it refused to warn anyone else such as they Navy or plaintiff.

II. WESTINGHOUSE DOMINATED THE NAVY'S PROCESS BUT FAILED TO COMPLY WITH ITS REQUIREMENTS

CBS/Westinghouse concedes (see page 4) of the brief that the manufacturers told the Navy how to write the specifications for the products of importance. These specifications included the requirement for warning of hazards the use of products but Westinghouse refused to warn (Exhibit I & J).

The Navy has required manufacturers to warn of the hazards of the products since 1936 (Exhibit I, specifications, Exhibit J, Faherty affidavit). As the years went by these requirements became more and more strict and more clear, requiring compliance with state and federal rules on warnings (see e.g. MILSPEC 15071E) as discussed by Faherty in his affidavit.

III. WESTINGHOUSE'S EXPERT DEMONSTRATES WESTINGHOUSE KNEW MORE THAN THE NAVY

Westinghouse failed to show that the Navy knew of the hazards of mesothelioma.

Forman's declaration creates a jury question on the facts. Further, as discussed below the Navy's conduct is irrelevant to this case which involved the duty of CBS/Westinghouse to plaintiff. The best Westinghouse can do is the report of Dr. Forman. He opines that the Navy was concerned about industrial hygiene in yards and ships. His conclusion are not helpful. At paragraph 42 he notes that the Navy erroneously believed that pipe covering was not a hazardous trade in 1946 and for years after. Further, all his emphasis on pipe covering is not the electronical products at issue here. Forman concedes that the Navy lost interest in asbestos hazards after Fleischer Drinker report, by contrast Westinghouse knew was warning insiders of the hazards but not the Navy or Kraus. Any post 1968 knowledge or activities of the Navy is irrelevant as Kraus had left the Navy. Nor did Forman discuss the Navy's knowledge of cancer. That failure means there was none. Even more relevant is that Forman admitted he is not an expert on military specifications (Exhibit K). In *Briener* he admitted the Navy was concerned for insulators not sailors (46, 57) based on the erroneous conclusions in the Fleischer Drinker paper. Sailors were not thought of as at risk (58). He testified in *Learn* that he saw no evidence the Navy knew of hazards associated with particular products (98). In *Willis* he specifically testified he saw no documents from the barring label of hazardous materials (43-44). He also stated in *Willis* he was not an expert on the requirements in military specifications (44-45).

Further as he testified in Learn at page 32 the Navy focused on shipyards not any sailors. Throughout his many depositions Dr. Forman has admitted that:

1) The Navy was mislead by the Fleisher Drinker report into believing asbestos was not hazardous to insulators, let alone sailors.

2) The navy never changed its belief until the 1970's.

3) The Navy only focused on insulators and not other trades including sailors or electronic communication workers.

4) He is not an expert on military specifications.

5) He does not know what the Navy's views on warnings was. The relevant portions of these of his depositions are attached and referenced above.

Thus, Westinghouse knew more than the Navy according to its own witness since it warned of the hazards of the products Kraus was near to its own worker but no one else.

CHOICE OF LAW

Defendant is in error on the choice of law here. The case began in Pennsylvania under Pennsylvania law here. The case began in Pennsylvania under Pennsylvania law. It was removed to This Court on a federal defense to Pennsylvania law. Once it arrived here, 28 USC§1333 came into play. This statute provides that in maritime case, while federal courts have the power to adjudicate maritime law[2] they must save to suitors all other remedies to which they are otherwise entitled. Thus, while maritime law can be applied so can and should Pennsylvania law be applied as well.

ARGUMENT

I. REGULAR AND FREQUENT EXPOSURE TO WESTINGHOUSE EQUIPMENT IS SHOWN

Despite CBS' verbiage it has failed to negate the following facts which can be gleaned from the record:

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[2] The case law is clear that maritime jurisdiction does not confer subject matter jurisdiction on the federal courts.

1) Plaintiff had over 200 exposures to Westinghouse equipment being opened.

2) The Westinghouse equipment contained asbestos.

3) Every one of the 200 times the Westinghouse equipment was opened dust from decaying or fraying asbestos products spilled out which he inhaled.

4) No one else supplied the equipment at issue except Westinghouse.

5) Bystanders can recover under maritime law, see *Damon v. Westinghouse* or Pennsylvania law, see *Rost v. Ford* 151 A.3d 1032 (Pa.2016).

6) Westinghouse knew more than the Navy about the hazards of asbestos.

II. THE GOVERNMENT CONTRACT DEFENSE IS A JURY QUESTION AT BEST

While some district court such as in Louisiana *Templet v. Avondale,* 274 F.Supp.3d 469 (EDPA 2017), or Massachusetts (see e.g. *Holdren v. Buffalo,* 614 F. Supp 2d 129 DMASS 2009) as so unimpressed that this defense has merit that they routinely remand cases removed on this basis to state Court, most Courts agree that it is a color able defense that confers subject matter jurisdiction on the district court.

Providing jurisdiction for a jury trial is not the same as providing a basis for summary judgment to defendants. Judge Robreno reviewed this matter at exhaustive length in *Willis v. BW/IP*, 811 F.Supp.2d 1146 (ED PA 2011). In that case he reviewed the arguments of the parties. Focusing on the fact that *Willis,* like Kraus, had an expert who relies on the Navy documents that requires warnings he held that this rebuts the government specification defense sufficiently to create a jury question. It is suggested that his analysis of *Boyle v. United*

Technologies is the correct one. Under *Boyle*, 487 US 500, 512, 108 Sct 2510, 101 Led 2d 442 (1988) the defendant must show the government approved specifications, the equipment conformed to the specifications and it warned the government about the dangers. Government approved of warnings must transcend nor rubber stamping to be shielded from the state law liability *Hagen v. Benjamin Foster*, 739 F.Supp 783. Here defendants concede that they never complied with the specifications requirement of warning. Even more factual to the claim, their own expert concedes the Navy didn't realize the hazards of asbestos in the 1960's based on the flawed Fleisher Drinker report and was only interested in the asbestos problem for insulators ignoring other workers such as Plaintiff. Further, Westinghouse knew that the precise asbestos products at issue were dangerous. Yet it failed to warn the Navy what it knew. It cannot benefit from *Boyle*. The Court may consider this a jury question but that is not summary judgment. Further, its expert is not an expert on specifications while plaintiff's expert is an expert on military specifications. These required a warning. Westinghouse despite its knowledge, chose not to warn. Defendant has not shown that compliance with Navy warning requirements interferes with military purposes. In *Boyle* as in *Brown v. Caterpillar*, 741 F.2d 656 (3rd Cir 1984), the government was proved to have required the manufacture not to adopt safety precautions. Here defendant has only rank speculation from its witnesses that the Navy would have barred Westinghouse from complying with the Navy's clearly mandated specifications and warning. This certainly creates a jury question.

Defendant has failed to offer evidence that is so clear that the Navy knew asbestos caused cancer.

III. PUNITIVE DAMAGES IS PROPER

Under either Pennsylvania or maritime law plaintiff has demonstrated that Westinghouse knew of the hazards of asbestos had the obligation to warn under the Navy specifications and still chose not to warn sailors like Kraus. This presents a jury question on entitlement to punitive damages.

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vs.	:NO. 18-CV-2119
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ORDER

AND NOW, to wit, this _____ day of _____, 2020, **CBS** Motion for Summary Judgment is hereby **DENIED**.

BY THE COURT:

_____ J.

EXHIBIT A

IN THE COURT OF COMMON PLEAS

PHILADELPHIA COUNTY, PENNSYLVANIA

- - -

ROBERT J. KRAUS and MARGARET M. KRAUS, h/w	:	APRIL TERM, 2018
v.	:	
ALCATEL-LUCENT, et al.	:	NO. 3448

- - -

November 27, 2018

- - -

Videotape trial of ROBERT KRAUS, taken pursuant to notice, was held at the offices of Magna Legal Services, 1635 Market Street, Philadelphia, Pennsylvania, commencing at 9:40 a.m., on the above date, before Melissa Broderick, a Professional Court Reporter and Notary Public for the Commonwealth of Pennsylvania.

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candidate school. If they accept you, then you go to Newport, Rhode Island, and you basically study Navy. You study leadership. You study everything you ever wanted to know about the military, what is it is and what your status in the organization and so forth. They teach you navigation and a lot of the things associated with sailing.

Q. What did -- what was your job duties in the Navy?

A. So after I graduated from OCS, I accepted the commission as an ensign. I'd actually been an enlisted man. When you go to OCS, if you fail out, you would end up in the enlisted Navy.

So I have two honorably discharges, one from there, one from officer candidate school, and the second from the Navy.

But my assignment, I was -- the day after I was commissioned, which was in June. I don't remember the exact

date, but it's in my data here -- I was ordered to report to a ship, the USS Cambria.

And it was actually a two-step process. First, I was supposed to report to training school in, I think it was, Little Creek, Virginia. Because the Cambria is an amphibious Navy -- it's one of the ships that carries the Marines -- we traveled in a squadron, and so I needed to know more about that. So they sent me to school for that.

The ship was in the Mediterranean at that time. It came back to the states. And so as the -- I was appointed the electro -- electronics material -- EMO. I think it's electronic material officer was the title they gave me. It had specific responsibilities.

Q. What were those?

A. And I was responsible for every piece of electronic equipment on that ship working constantly and regularly.

Q. Can you describe types of -- when you say electronics equipment, what are you talking about?

A. The two biggest things we had were two radars. We had an air search radar and surface search radar. The air search radar would see out about 300 miles. And that's what it did. It looked for aircraft. Also, looked for missals --

Q. Okay.

A. -- that were aimed at the ship.

We also had a piece of equipment, electronic countermeasures equipment, which was used to try to confuse any missals, if they were sent at our ship. So that's the air search radar.

We had a surface search radar, which is just as important. In my opinion, these were about two of the most important pieces of equipment on the ship, because without them, you can't

see. You can't see enemies. You can't see anything you might run into. We would typically sail darkened ship when we were in a squadron.

The brunt of the equipment was the radios. We had radio, transmitters, and receivers. Last count, we had almost -- that I did from a list I prepared -- and you've all seen that, I think -- we had over 300 -- after the ship had an overhaul, it was shortly after I went aboard the ship -- we had over 300 pieces of electronic equipment on the ship.

Q. What did you have to do with the electronic equipment?

A. It was considered a managerial job, or you could also consider it -- I mean, it was largely administrative. What I did is I actually worked -- I worked out of the ET shop.

Q. What is that?

A. Which is a shop on board the ship that was specifically for

maintaining and repairing all the electronic equipment.

And so I was responsible for making sure that all of the regulations -- and the Navy has a lot of regulations on when and where and what happens to every piece of that equipment. As a matter of fact, at one point in time, I had to sign for every piece of equipment, okay.

And so there were periodic maintenances that were required for different -- it varied depending on the piece of equipment. And we had a lot of other types of equipment, too, besides radios, but I won't go into that for this second.

But each piece of equipment had its own special card, okay. And it kept track of -- and other documents that went along with that -- kept track every time that one of those pieces of equipment came in, when it was maintained, when it was due for another

regular maintenance.

And we made changes to the equipment periodically, if it was improved or updated, and we would do some type of an alteration. A lot of these things were called ship alts.

And so I was just there for that purpose, to make sure that -- that position was to monitor, make sure that all of these things were done. If there was a particular issue with a particular piece of equipment, I had to know about it. I had to do something about it.

We've had situations where -- we had 24 landing craft on board that ship to land 1200 Marines that we carried. And the radios we were using on those boats, when we put the Marines in the water on our boats, they'd typically go out, and they would circle until they were all in this formation. They had to be able to communicate with the ship. They had to be able to communicate with each other. And they were still using

World War II radios that they were constantly breaking down.

So that was one of the things we had to find a resolution for, that is, me and -- I had the chief petty officer. That's equivalent to a sergeant in the Army, if you're not used to Navy lingo. And, eventually, to a master chief petty officer, as my ET crew grew from 12 to some higher number, 15 or so.

So it was an administrative job that doesn't sound very sexy, but it had an awful lot of problems that we had to work out.

Q. Well, you've mentioned -- used a couple of terms, and I wanted to ask you about those. You used the term "periodic maintenance" a minute ago.

A. Uh-huh.

Q. What is periodic maintenance? What happens in a periodic maintenance?

A. Typical piece of equipment -- most of the equipment on -- the

electronic equipment was rack mounted.

Q. What does that mean?

A. And that means there were literally these racks -- these structures that are like a framework. And there -- a lot of them are in the radio -- I say radio rooms. We had about -- I think, up to five radio rooms on the ship, because we were the flagship, so we carried the flag officer. He had all of his own -- duplicated everything we had except for the radars.

So maintenance, we would bring the piece of equipment in. We'd take it out of the rack. So now, where you could originally see the front panel, but you couldn't see the rest of the particular electronic equipment, when you took it out, you could see all of that because it was cabinets that enclosed it were still sitting back in the radio room.

We'd bring it down to the ET shop. And the first thing they would do

is they would clean it, okay.
Q. When they cleaned it, what did they do?
A. There were two different ways they typically cleaned it. One, they used a vacuum, and would vacuum out every part of the radio they could get to.
And the second was -- well, they used some chemicals periodically, if there was corrosion, or if there were problems with any equipment making proper contact with switches, for example, that were in there. We would -- so that was it.
DEFENSE COUNSEL: Belated objection. Overbroad as to equipment and time.
BY MR. PAUL:
Q. Why did the radios and these other pieces of equipment have to be vacuumed?
A. Easiest way to say it is they got dirty. It's like anything else

in your house, if you let it sit there for a long time -- and they were -- and they were hot, typically.
DEFENSE COUNSEL: Same objection.
THE WITNESS: Most of the radios had electronic tubes. Some had electronic tubes and transistors, a combination. And if you've ever looked in anything -- any piece of equipment, like your TV, for example, at home, it's going to get very dusty inside.
And so that's basically what they were doing, vacuuming whatever dust was in there.
BY MR. PAUL:
Q. What do you recall -- do you recall any components of these radios?
DEFENSE COUNSEL: Objection. Overbroad as to equipment and to time.
MR. PAUL: You can answer

the question.
THE WITNESS: Could you repeat the question?
MR. PAUL: Yeah. Have it read back.
- - -
(The court reporter read the pertinent part of the record.)
- - -
DEFENSE COUNSEL: Also compound.
THE WITNESS: I'm not sure what you mean by components, but, for example, there were circuit boards.
BY MR. PAUL:
Q. Circuit boards?
A. If that's what you're talking about, yeah, circuit boards.
Q. Okay.
A. The tubes themselves. They were all components. So if a tube went bad, you could pull it and replace it.
Q. Okay. Circuit boards, you

have to pull circuit boards yourself?
A. We would --
DEFENSE COUNSEL: Same objections.
THE WITNESS: There were two ways -- two kinds of ways to take care of circuit boards problems. One, you could find out if there was component that was bad, for example. Well, the tube I just mentioned. But they both have circuit boards.
But the transistor, you could detect a bad transistor and replace that. Sometimes, if you couldn't find the problem in the circuit board, then you replace it, yeah.
DEFENSE COUNSEL: Move to strike nonresponsive portions.
BY MR. PAUL:
Q. Was there any kind of cloth or pad inside the radios?
DEFENSE COUNSEL: Objection;

form, leading. Same objections. Vague and ambiguous.
THE WITNESS: Okay. I thought we were talking about components. But there was a practice of -- especially in the compound equipment.
BY MR. PAUL:
Q. In what?
A. The compound equipments, the ones that had the tubes and semi-conductors. There were also diodes, besides transistors.
THE COURT REPORTER: There were also what?
THE WITNESS: Semiconductor diodes, D-I-O-D-E-S, plus transistors.
And so we were -- actually used, in some equipment, pads. They were heat insulating pads between the transistors and the tubes, if they happened to be in the proximity.

DEFENSE COUNSEL: Move to strike nonresponsive portions.
BY MR. PAUL:
Q. Where were this heat insulate -- where were these heat insulating pads in terms of the radios? And was it about the same from radio to radio, or if you know?
DEFENSE COUNSEL: Again, objection, vague.
THE WITNESS: Well, first of all, they weren't used in all radios, okay, or electronic equipments, but they were used where there was a need. I imagine, sometime before I was in there, they might not have even had them.
But when you start to put transistors in -- that was the main upgrades that they made at some point in time in a lot of the electronic equipment. So once they start putting transistors in,

they still had tubes.
And let me tell you why they do -- did that, why they used both. The transistors, the power transistors, at that time they really weren't good enough to -- or powerful enough to generate the energy needed for very high-powered radios. So we left that job to the transistors -- I mean, I'm sorry, to the tubes.
But that's -- how often were they used? I really don't recall. I just know that that was one instance when they used an item like that.
DEFENSE COUNSEL: Move to strike the nonresponsive portions.
BY MR. PAUL:
Q. What was in the circuit board? You mentioned a circuit board a couple minutes ago. What was in the circuit board, if you know?
DEFENSE COUNSEL: Same

objections.
THE WITNESS: Well, there could be one circuit board. There could be many circuit boards. There were different -- they performed different functions.
For example, amplifier would be a typical function. That could have one circuit board. I don't really recall anymore exactly. I presume, just to my knowledge as an electrical engineer, they probably had different circuit boards that were used for the tubes, in some cases, in the transistors.
BY MR. PAUL:
Q. Do you know what a --
DEFENSE COUNSEL: Move to strike -- move to strike based on speculation and -- nonresponsive portions.
BY MR. PAUL:
Q. What was the -- what did a

circuit board look like?
DEFENSE COUNSEL: Overbroad, compound.
THE WITNESS: Well, the board itself -- and I'm trying to remember this now.
BY MR. PAUL:
Q. This is in 1960, so --
A. I'm trying to distinguish, too, between when I worked it -- yeah --
Q. Right.
A. -- later.
Q. Right. Because we're talking about the 1960s at this point, right?
A. Yeah. I was in until '67. '64 --
Q. Right.
A. -- through '67, right.
Q. So you're talking about the circuit board. Go ahead.
A. Yeah, I think that -- I think these are the right ones. They were like a brownish color. Like, I

think they were called a phenolic board or whatever. It was insulating material.
And then it -- it would have tracks in it. So, for example, typically solder tracks, it looked like, in some of these. And that would be the conductors that would connect all the components.
And the components -- typical components in any circuit board are resistors, diodes, transistors, capacitors, coils, inductors, depending on the function -- depending on the function of the board.
For example, an amplifier would have, typically, a heavy power to it, as a triode or a tetrode, and it would plug into a socket. And that socket was actually -- was wired into that board.
Q. Okay.
A. Okay. And so you had circuits. You could have one circuit. You usually had several different circuits, depending on how big the board

was, what the equipment was.
And there was this little portable equipment that -- for example, those radios that didn't work so well I talked about before.
Q. Right. You mentioned them.
Do you know what arc chute is?
DEFENSE COUNSEL: Objection; leading.
THE WITNESS: An arc chute?
BY MR. PAUL:
Q. An arc chute?
DEFENSE COUNSEL: Leading, lacks foundation, assumes facts not in evidence.
THE WITNESS: All I know about arc chutes is what -- and I don't recall -- what I read -- after I found out I had mesothelioma, and I started reading about asbestos and all the places that asbestos was found.
I don't recall exactly what

it was, but it was considered to be one of the sources.
DEFENSE COUNSEL: Objection; hearsay, move to strike, nonresponsive.
BY MR. PAUL:
Q. My question was whether there was an arc chute in these circuit boards, if you know?
DEFENSE COUNSEL: Same objections. Compound, leading.
THE WITNESS: I really don't know. I'm not even sure if it would be applicable to the circuit boards.
BY MR. PAUL:
Q. Sir, based on your knowledge and training as an engineer, electrical engineer, were these pieces of equipment on the ship similar to what would be used in civilian life, or was there something special or unique about them being Navy equipment, if you know?
DEFENSE COUNSEL: Objection;

BY MR. PAUL:
Q. What did you do as part of that second overhaul?
A. Let me back up a little bit. So it was an unusual type of situation because we took the ship to dry dock in Philadelphia. Our home port was Norfolk, Virginia. We took the ship to the dry dock in Philadelphia, Philadelphia Naval Shipyard.
And then we kept on board the crew that was needed to do the electronic overhauls that we were going to do at that point in time. Okay. We lived on the ship. We took every piece of equipment that was on the ship, including the stuff from before -- that we had before, plus the new equipment that came aboard, and we overhauled or did whatever maintenance was needed to update the -- to make sure all of the changes to the equipment that was already on board were done.
And, effectively, we took --

except for the radars, I think every piece of equipment we had, we brought into the ET shop. And that was the main purpose for the ET shop.
DEFENSE COUNSEL: Objection; move to strike, lacks foundation.
DEFENSE COUNSEL: Move to strike nonresponsive portions.
DEFENSE COUNSEL: Can the court reporter read that last answer?
- - -
(The court reporter read the pertinent part of the record.)
- - -
DEFENSE COUNSEL: Move to strike speculative portions.
MR. PAUL: Okay.
THE WITNESS: Next, I heard -- are we still on?
MR. PAUL: We're still on. Yeah.
THE WITNESS: I mentioned that we didn't bring the radar in.

I think we missed that somehow, but...
THE COURT REPORTER: I said that.
THE WITNESS: Oh, you did?
THE COURT REPORTER: Yeah.
- - -
(The court reporter read the pertinent part of the record.)
- - -
BY MR. PAUL:
Q. All right. Well, let's talk about what was in the shop, and then we'll talk about the radar.
What did you see done in the shop during the second overhaul in 1965?
A. I lived in that shop basically. I mean, I wasn't standing watches. I wasn't doing any of my other duties. I mean, there were two rooms on that ship. You don't walk around on the ship in dry dock much. I was either in the ET shop, or I was in my room sleeping.

I saw every piece of equipment they brought in. I saw more than some of the ETs because they tend to work on certain pieces of equipment.
Q. What kind of maintenance --
DEFENSE COUNSEL: Move to strike the nonresponsive portions.
BY MR. PAUL:
Q. Okay. What kind of maintenance did you see performed on the equipment in the ET shop during the second overhaul?
DEFENSE COUNSEL: Objection; form, vague, compound, overbroad, lacks foundation.
THE WITNESS: It's a combination of different things they did. I forget the name they have for them, but they had -- I think they called them field changes. There was -- any type of a change -- as equipment aged, the Navy would make modifications. For example, they took some

radios, and they maybe replaced them with other radios that were solid state. So that would be a case where they would -- we would actually lose a piece of equipment. We'd get a substitute for it.

But for the most part, we would just look for changes that could be made in the equipment that's already on board, that would update the equipment -- particular equipment.

We had -- other things that we did, if there were any tubes -- any electronic equipments that weren't working properly, we'd service them, just the same as we would have if we were at sea. The only real difference was -- focus was that we weren't at sea.

And we brought every piece of equipment we had on board the ship because they were all -- we

could shut them all down. You can't do that when you're at sea.

BY MR. PAUL:

Q. Did you --

A. So we -- at least as a minimum, we'd take each piece of equipment, unless it had been done very recently, we'd clean it. If anything had to be adjusted, then we'd readjust it.

Q. What was the condition --

DEFENSE COUNSEL: Move to strike the speculative and nonresponsive portions.

DEFENSE COUNSEL: Can we move the microphone a little closer to the witness?

THE WITNESS: Oh, sure.

DEFENSE COUNSEL: Thank you so much.

BY MR. PAUL:

Q. What was the condition -- and this something -- we're going to go off the tape a minute -- what was the condition of the room where all this work

was going on?

DEFENSE COUNSEL: Objection; form, leading, lacks foundation, assumes facts not in evidence, vague.

THE WITNESS: It was very cluttered. It was very busy. I think we covered -- I mean, we had two long benches in the ET shop. We had -- when you have 12 ETs and -- in that space, which was a pretty good size for a ship, it was just -- it was a place you couldn't keep clean. Let me put it that way.

MR. PAUL: All right. Well, let's go off the video for a minute because we have to change the tape.

THE VIDEOGRAPHER: This concludes video 1. The time is 12:16 p.m. We are off the record.

(Off the record.)

THE VIDEOGRAPHER: The time

is 12:26 p.m. This is the beginning of video 2. We are on the record.

BY MR. PAUL:

Q. Okay. You were discussing earlier the equipment that was in the room. Okay? Are you able to -- today, to remember a specific one of the products that were -- that were on this chart that were in the room?

And I'm excluding the radar equipment for the moment.

A. Yeah, we didn't -- because we didn't bring the radar equipment in.

Q. Right. Of course, not. That's why I'm not asking about that.

A. It's too big.

I really don't, but I can say that our goal was to bring every piece of electronic equipment we had in. And even if we didn't do anything to it -- if we'd just, for example, maintained it, you know, the day before, we would at least check the card and make

sure, look on the list.

There was a lot of documents that we have here going back and forth saying, you know, add this -- this piece of equipment, we're going to lose that piece. But the object was to drastically increase the number of electronic equipments on board because this was a command ship. It was a command ship in a squadron. And they hadn't been able to do that back in '63.

And so we had equipment coming at us left and right. We were just -- it was just jam-packed in there. It was impossible to really clean that room thoroughly. I mean, they tried. And, of course, when they cleaned the equipment, they could do that, but it was cluttered in there.

DEFENSE COUNSEL: Move to strike the nonresponsive speculative portions.

BY MR. PAUL:

Q. So just so that we're clear,

P-7 was your attempt to figure out what pieces of -- well, why don't you tell me what -- I won't tell you what I think it is. You tell me, what was the purpose of P-7?

A. The purpose of P-7 was to put on a list every piece of electronic equipment that the Cambria had when it left the dry dock.

Q. Okay.

A. Okay?

Q. Okay.

A. And it wasn't impossible -- the only thing I think I didn't get on the list -- there might be more things that aren't on this list, possibly are, because when they did the previous overhaul in '63, I didn't have a complete set of documents, okay, for all the equipment that they had on board. Okay. So it might not have shown up on this list at all, but it would be -- the only thing that wouldn't be here would be additional documents, because I did have

-- for additional equipment, because I knew we did all of the equipment that we knew about.

Q. All right. So the first document -- the first column, then, was to identify the equipment and to identify what type of equipment that is. Am I reading P-7 correctly?

A. Yeah. The first document identifies equipment by its Army/Navy number. That's just a nightmare. Sometimes -- they don't use AN. They use KW, or they use some other number.

Q. Okay.

A. It also has some components on here. I stopped, actually, adding them to the list because I thought, it's going to be in a piece of equipment somewhere, but it's on here for now.

Q. How did the names that appear on the right-hand column -- where did they come from?

A. On the right-hand column?

Q. Yeah, the right-hand column.

A. Source column?

Q. The source column, yeah.

A. Okay. You supplied me with some of these. I got some of these myself. But what I did is -- first, I asked you, because you had some sources, I guess.

DEFENSE COUNSEL: Objection.

THE WITNESS: Then I went on -- I went online, and I looked everywhere I could find.

And all these equipments -- there are a group of people that, as a hobby, they actually run -- they set up radio rooms. And they have a lot of information on their websites as to what equipment goes with what. You know, what number radio -- AN number radio, what it is, what kind of equipment it is, what it's used for.

And so I had sources like that. I had sources from the manufacturer. Every place I could

going to get to that in a minute.
Do you recall being exposed to any particular ones of these products or not?
DEFENSE COUNSEL: Objection; form, vague, ambiguous, lacks foundation, calls for speculation, assumes facts not in evidence.
THE WITNESS: The answer is, no, I really don't recall any particular -- this was 50 years ago, and I have to stretch to remember some of the things I do remember. It's one of the reasons I did a lot of research.
BY MR. PAUL:
Q. Right. Well --
A. But I don't remember, you know, which equipment. I just -- all I know is all the equipment that Cambria had on board that ship was at least monitored and usually changed. But each one of them was brought down to the ET shop because everything was there for the

picking. We could take any piece of equipment.
We actually -- during this overhaul, we actually -- some of the crew from the shipyard actually moved walls. We changed some of the equipment around. Some ended up going into the flag officer's quarters -- or their offices, which are up -- high up in the ship. But every one of these pieces of equipment was there for us to take because nobody was using them. None of these people were aboard. And that's why we were very busy. And that was our function.
DEFENSE COUNSEL: Move to strike the speculative and nonresponsive portions.
BY MR. PAUL:
Q. You mentioned a radar?
A. Yeah.
Q. Is that a separate piece of equipment that was not worked on in the shop?
A. Yeah, it was too big. The

-- we had two radars, as I said.
DEFENSE COUNSEL: Objection --
THE WITNESS: The air search radar was very, very big.
DEFENSE COUNSEL: Objection; overbroad.
THE WITNESS: It had -- it was at the top of a mast. Actually, I'll just take them one at a time. That's the SPS 40. It was at the top of a mast.
BY MR. PAUL:
Q. That's the SPS 40, you said?
A. The AN SPS 40.
Q. Okay.
A. At the bottom of the mast was -- masts are huge on those ships. Okay. They're hollow. They're steel -- was a door that you -- when you opened the door -- and that's where the electronic equipment for the SPS 40 was located.
Similarly, the SPS 10, there

was another opening where that was maintained, and that was on a different mast. The SPS 40 was on one of the masts on the front of the ship. The SPS 10 was on one of the masts more near the center of the ship.
But they each had the two rotating antennas. There was a transmitter and a receiver to transmit a pulse, which would bounce off and then the receiver would receive it and amplify it. And it would show up on your -- the scanner that we had, the oscilloscope. I forget -- I forget the real name for the screen that the people that were on board -- CIC and ever who else -- we had what we called repeaters, where they could look, and they could see these blips, and they could interpret them as whatever, surface craft, aircraft.
DEFENSE COUNSEL: Move to strike the nonresponsive portions.
BY MR. PAUL:
Q. Did you, yourself, work on

EXHIBIT B

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF PENNSYLVANIA

ROBERT J. KRAUS and
MARGARET M. KRAUS, h/w,

Plaintiffs,

vs. No. 18-2119

ALCATEL-LUCENT, et al.,

Defendants.

VIDEOTAPED DEPOSITION OF ROGER GOSSETT

Suffolk, Virginia

Tuesday, August 20, 2019

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REPORTED BY: DEBRA-LYNN BAKER, RPR, CSR

problem, you know, reading that either because I, you know, pretty much understood what was going on there. And when I -- I went in the navy, like I said, in October of 1962 as an ET-3, and one year later I was promoted to ET-2 --

Q Okay.

A -- to a --

Q And in order to do that, you had to study the --

A You had to take a test in the navy. Yes.

Q And you passed that test?

A Yes.

Q Okay. What was the first ship that you were on?

A I was on -- first ship was assigned -- I was assigned to the USS Cambria, APA-36.

Q Okay. And in what capacity were you assigned to the Cambria?

A I was an electronics technician in the -- the mess with everybody else. There was probably 15 -- 14, 15 of us in the electronics gang.

Q Okay. There were about 15 of you in

the electronic gang?

A I don't remember the exact number, but it was about that. Yes.

Q All right. So we're talking about -- this is now 1963?

A Yes.

Q Okay. What were your duties as an electronics technician on the USS Cambria?

A I was --

Q Start with your --

A -- charged mainly with --

DEFENSE COUNSEL: Objection.

BY MR. PAUL:

Q Start with your -- start with your 3. I'm going to -- start with your 3 --

A Okay.

Q -- duties and --

A As an elect- --

Q -- then we'll work our way up.

A -- as an ET-3 --

Q Okay.

A -- I was --

DEFENSE COUNSEL: Object to the --

THE WITNESS: -- charged with --

DEFENSE COUNSEL: Well, hold on.

Just need to put an objection on, sir.

THE WITNESS: Pardon?

DEFENSE COUNSEL: I am just going to put an objection on the record.

THE WITNESS: Okay.

DEFENSE COUNSEL: Object to the question as vague, ambiguous, compound, and lacking time and scope.

BY MR. PAUL:

Q Okay.

DEFENSE COUNSEL: Could we just get a running objection --

MR. PAUL: You can certainly have a running objection.

DEFENSE COUNSEL: -- to vague, ambiguous, overbroad --

MR. PAUL: Sure, sure.

DEFENSE COUNSEL: -- lacks foundation, calls for speculation --

MR. PAUL: Yeah. Absolutely.

DEFENSE COUNSEL: -- assumes facts not in evidence.

MR. PAUL: Okay.

Q Okay. Go ahead. So the quest- --

DEFENSE COUNSEL: Leading.

MR. PAUL: I'm sorry.

DEFENSE COUNSEL: Vague and -- I think that will do it.

MR. PAUL: All right. Why don't you read me the question back, so we don't have to go through this again.

Read the question back, ma'am.

Because then all the objections will be deemed having been made and we don't have to do it again.

Go ahead, read the question back.

(Record read.)

THE WITNESS: Okay. I was -- we had -- in this division we had two subdivisions, I guess you'd call it, the radar guys and the communications guys. I was part of the communications. Specifically, my rate was an ETN-3, the N designating comm- -- communications.

We had receivers, we had transmitters, we had, you know, the connecting equipment, antennas, teletype machines, converters, this type thing, having to do with communications off the ship --

BY MR. PAUL:

Q Okay.

A -- to various and sundry people.
Q Okay.
A And I -- some of the equipment I was familiar with from the air force, some of it was -- I got used to it.
Q Okay. Well, let's talk about what you remembered from the air force that was similar. Let's start with the familiar stuff, and then we'll get to the unfamiliar stuff.
A Okay. The -- the main thing that I was familiar with in the air force was the radio receivers designation R-390 Alpha/URR, and it was the same equipment that was in use in the air force as the navy.
Q Okay.
A So I was familiar with that one.
Other receivers, shipboard-type receivers, we did not have those in the air force. It was basically the same thing, it's just in the navy they're -- they buy them from a different manufacturer, they're made different for ruggedized at sea and so forth and so on.
Transmitters, they were all new. I didn't have any idea of what -- what the transmitters looked like when I first got aboard

ship --
Q Okay.
A -- but, again, it was easy enough to pick up.
Q Okay. What -- let's go back to the receivers for a sec. What receivers do you recall being on the Cambria when you got on in '63?
A Well, there was the R-390s.
Q All right.
A There were -- SRR-13, I believe the designation is, was an HF receiver, and an SRR-11 was an LF receiver.
Q Those -- HF stands for high frequency --
A High frequency, yes.
Q -- LF stands for --
And LF stands for --
A LF is low frequency.
Q Okay.
A Yes. And then we also had the URR-13 receive- -- URR? No, I'm not sure of that, but the UHF receivers --
Q Okay.
A -- which, again, you know, the only

difference is the frequency range, the UHF, ultra high-frequency.
Q Okay. You mentioned the transmitters. What transmitters do you recall being on the ship at that time?
A On the transmitters, there was an AN/SRT-14, which was a 100-watt transmitter; an SRT-15, which is a 1- -- 100-watt transmitter with an amplifier to make it up to 500 watts, and then an SRT-16, which was the 14 and 15 combined into one unit, so we had basically two transmitters in one unit.
Q Okay.
A That was the HF.
There was a WRT-1 low-frequency transmitter.
And as far as UHF and VHF, there were TEDs and REDs, T-E-D and R-E-D, for transmitters and receivers. It was an older navy designation, didn't have the AN/ in it.
Q Okay. So we're now in 1963, right?
A Yes.
Q Okay. What did you have to do -- you -- who was the supervisor at that time? Was that you, or was it somebody else?

A No, no, I was -- I was low man on the totem pole when I first got there.
Let me see. Frank Green was the name of the first class in charge. He departed something like six months or so after -- after I got there, he got out, which was -- the basic problem with the navy at the time is all the ETs are getting out. So as the ETs got out, I assumed more and more, you know, responsibility on what I'm doing, and by the end of '64 I was promoted to ET-2, electronics technician second class, and I was pretty much in charge of the -- the electronics gang.
Q So all 15 of these fellows at that point were --
A Yeah.
Q Okay.
A Again, the number is, you know, nebulous in my mind.
Q Right. Sure. Let me talk a little bit about some of these pieces of equipment.
A Sure.
Q What did you have to do with the 390?
A The 390s were -- it was -- it's a modular receiver where bunches of different

A Yeah.
Q -- what did you have to do to that wire?
And, again, I'm talking about the 390 for the moment. I'll get to some of the other stuff in a bit.
A Well, it's just a matter of determining, you know, you need a wire that's this long or that long, you cut it off, you strip the ends off of the insulation off the wire to expose the conductor and solder it back into place --
Q Okay.
A -- whether it's, you know, 2 inches long or a foot long.
Q What happened when you -- when you cut the wire, as you describe it? Did you see anything happen, or did you see anything in the air?
DEFENSE COUNSEL: Objection; form.
BY MR. PAUL:
Q You can answer the question.
A No. Well, when you cut the wire, the insulation -- you have special cutters for the wire which, you know, will cut the insulation but

not the wire.
Q Yeah.
A And once you cut it, the insulation goes flying into the trash can or on the floor.
Q Did it ever fly in your face?
DEFENSE COUNSEL: Objection to form, leading.
THE WITNESS: No.
BY MR. PAUL:
Q Okay.
A You've got to be careful, you know, you don't do things like that.
Q Right. Were there any other pieces or components of the R-390 that you recall?
A Mechanical components.
Q Well, tell us about electronic.
A Yeah.
Q Okay. What's a resistor?
A A resistor is a piece of electrical equipment that's made to -- to impede the flow of electronics, and how much it impedes it depends on how it's made. You can get them that are very low resistance or very high resistance --
Q Okay.
A -- and --

Q Do you know how they're made?
A Basically, yeah. A bunch of -- first of all, the engineers determine what resistance they need. Okay? They're made in certain steps. The compounds that -- the resistive conductive compounds are chosen to provide this plus-or-minus resistance.
Q Okay.
A And then they're incorporated into a package with other stuff to keep them -- what can I say? To keep it together --
Q Okay.
A -- okay, with two wires sticking out the end.
That -- that's strictly the -- the manufacturing process. Okay? That has nothing to do with my end where I --
Q Sure.
A -- replace the resistors.
But that's -- yeah, that's --
Q Do you know any --
A -- that's basically how I -- how I know a resistor is made.
DEFENSE COUNSEL: Move to strike, lacks foundation, basis of foundation,

speculation.
BY MR. PAUL:
Q Do you have any knowledge about what the compounds were made of?
A No, I haven't the slightest.
Q Now, we're talking about the 390 for the moment.
A Okay.
Q Was there a difference in resistor -- well, were resistors used in lots of other -- in other equipment?
A Yes.
Q Okay. What other pieces of equipment were the resistors used in that you recall?
DEFENSE COUNSEL: Objection. Again --
THE WITNESS: Every piece of electronic equipment on the ship has resistors in it.
BY MR. PAUL:
Q Okay.
A Whether it has -- you know, the number is -- depends on the complexity of the equipment. Some of the -- the transmitters had hundreds of resistors.

Q Okay.
A Some of the smaller components had two or three.
Q Okay. Well, take the ones that had hundreds. Can you recall which ones had hundreds of resistors in them?
DEFENSE COUNSEL: Object to form.
THE WITNESS: The SRT series transmitters. They were -- they were monstrous equipment that -- they stood 6 feet tall and 3 feet wide and 3 feet deep.
BY MR. PAUL:
Q Okay.
A And there was a lot of electronics in it.
Q Okay. Well, let's talk -- well, all right. The SRT-13, let's --
A Yeah --
Q -- see if I can --
A -- SRT-14, 15, 16.
(Plaintiffs' Exhibit 12 was marked for identification by the court reporter.)
BY MR. PAUL:
Q Okay. All right. Let's turn to what

I have previously marked as P-12. Okay. This is the SRT, not the SRR-13, this is the SRT-13.
A SRT --
Q Okay.
A -- yeah, 14, 15, and 16.
Q Let's see if I have --
A It's T for transmitter.
Q All right. Hang on a second.
Let's go off the video for a moment, please.
THE VIDEOGRAPHER: We're off record at 9:40 a.m.
(Discussion off the record.)
THE VIDEOGRAPHER: We are back on record at 9:41 a.m.
BY MR. PAUL:
Q Is there a difference between an SRT-13 that you just mentioned --
A The SRT series, there's a 14, 15, and a 16.
Q Okay. Are they all about the same, then?
A Well, like I said, the SRT was a smaller 100-watt transmitter.
Q Right.

A As far as physical appearance, it's probably 5 feet tall --
Q Okay.
A -- a foot, a foot and a half wide, and a couple of feet deep.
The SRT-15 is an SRT-14 with an amplifier beside it which --
Q Okay.
A -- doubles the width.
Q Okay.
A Okay? And an SRT-16 is an SRT-14 and an SRT-15 combined. So you -- in an FR -- SRT-16 you have -- basically have two transmitters, a hundred-watt transmitter and a 500-watt transmitter, both of which operate independently.
THE VIDEOGRAPHER: You're covering your mic.
BY MR. PAUL:
Q All right. We talked about -- you mentioned an SRR-13.
THE VIDEOGRAPHER: I'm sorry, you're covering your microphone, sir.
MR. PAUL: Oh, sure.
THE WITNESS: Oh, okay.
BY MR. PAUL:

Q You mentioned the SRR-13?
A SR- -- I'm not sure on the S- -- it's an SRR -- it's a receiver.
Q Okay.
A A small thing about this tall --
Q Okay.
A -- and 19 inches wide.
Q Okay.
A It's used mainly strictly to receive. Again, it's a piece of electronic equipment. It's fairly complex.
Q Okay.
A But --
Q So it has resistors in it?
A Yes, it does.
Q Anything -- any other pieces of equipment that it has in it?
A Everything -- every piece of electronic equipment has resistors in it.
Q Okay.
A Okay? Like I said, it may be 3, it might be 200.
Q Okay. What's a capacitor?
A A capacitor is an electronic component that is used to store electrical energy

or to pass a signal through, depending, again, on the way it's built.
Q And were there capacitors on the Cambria?
A Oh, yes.
Q Tell me about that.
A Well, capacitors are just about as ubiquitous as resistors are in most electronic equipment.
Q Okay.
A Yeah, it's -- you know, today, with the integrated circuits and all this stuff, they're -- they're out of sight. But back then, you made electronic equipment out of resistors, capacitors, tube sockets, coils, you know, various small parts.
Q Okay. What's -- how is a capacitor made, if you know?
DEFENSE COUNSEL: Object to form; calls for speculation.
BY MR. PAUL:
Q You can answer the question.
A Capacitor? Well, let's see. The basic capacitor is two pieces of conducting material, aluminum, copper, whatever you want to

call it, with an insulating material in between rolled up into a small or a large, depending on what you -- you're building it, so that the two wires connecting the two different metal plates or conductive surfaces --
Q Okay.
A And it can be an itty-bitty little thing like, you know, your fingernail, or it can be that big and stand a foot tall, again, depending on what you're building it for.
Q Okay. What's this insulat- -- if you know, what's the insulating material that you just described a minute ago composed of, if you know?
DEFENSE COUNSEL: Object to form, calls for speculation.
THE WITNESS: The only materials that I know of personally, because I have taken capacitors apart on occasion, just out of curiosity, is wax paper or some type of insulating paper with something on it to keep it from drying out and then wrapping the whole shooting match in -- in a coat -- coating to protect it from the environment.
BY MR. PAUL:

Q Okay. Do you know what this insulating paper that's not wax paper was made of, if you know?
A No, I do not.
Q All right. You mentioned -- I am going down -- URR-13?
A Yeah. I believe that is a -- if I remember correctly, that is the UHF receiver --
Q Okay.
A -- ultra high-frequency receiver.
Q Is -- is there a difference in the composition and the -- and the -- of that product from these others that you have mentioned so far?
A No. The only difference is the frequency range in which they operate.
Q Okay. They all, basically, are designed and constructed the same way?
A Yes.
Q Okay. They came in a box, like in a metal box?
A Yes. Everything came -- come in a metal case. Especially, you know, being shipboard, it has to be ruggedized for --
Q Sure.
A -- when we're having fun in the open

ocean.
Q Sure. Did -- did -- do you recall if there was any cloth or board or paper inside the box or any other kind of material inside the boxes?
DEFENSE COUNSEL: Objection; leading.
THE WITNESS: No.
BY MR. PAUL:
Q Okay.
A Now, most -- most all shipboard equipment is made ruggedized with metal, aluminum or steel --
Q Right.
A -- or whatever, you know.
Q Sure.
A There -- there's hardly any -- paper or light material like that would -- would be fragile.
Q Okay.
A It's hardly ever used on shipboard.
Q Okay. Do you remember any board, any heavy board or anything like that inside metal boxes?
DEFENSE COUNSEL: Same objection.
DEFENSE COUNSEL: Objection; asked

and answered.
BY MR. PAUL:
Q You can answer.
A Well, circuit boards are made in some of the equipment to plug in and, you know, circuit boards are made of fiberglass, to my knowledge, with the components mounted on them and then some sort of a clear plastic, plastic used in the generic sense, some kind of a sealer to prevent them from getting wet, getting dirty.
Q Do you recall any particular pieces of equipment that had circuit boards?
A Oh, yes.
Q Okay. Go ahead.
A Yeah. The cryptographic equipment, especially, had many circuit boards in it. That's the KWR-26 and the -- KWR-37, the KW-26, KW-7s, they were all pretty much modernized up to where they had 90 percent circuit boards.
Q Okay. And did you have -- where were these -- you did maintenance on these products?
A Yes.
Q Okay. And what part of the ship was that done in?
A Well, if you maintain a circuit

board, you pulled it out of the equipment, brought it down to the shop and troubleshot it right there in the --
Q Okay.
A -- in the shop.
Q Okay. When you opened up the equipment, what did you have to do to the equipment? And, again --
DEFENSE COUNSEL: Object to form, as overbroad.
BY MR. PAUL:
Q Again, we're -- we're talking about either the SRR-13 or the SRR-11 or the 390A or the URR --
DEFENSE COUNSEL: Same objection.
THE WITNESS: Yeah. Well, you know, depending on how the thing is made, it's -- once you get the equipment open to where you can get at the insides, there's a couple of screws or many screws that you have to take loose to get the module or the circuit board out.
BY MR. PAUL:
Q Okay.
A Pull it out, take it to the shop and fix it.

Q Did you ever have to use a vacuum cleaner?
A Yes.
Q Tell me about that. Why would you use a vacuum cleaner?
A Probably once a month, every couple of months you'd open the equipment up, vacuum it out, because dust collected in there, and it was part of our -- let me see. The name of the system was POMSEE. I don't, exactly, know what that stands for, but it was a preventative maintenance shipboard electronic where you cleaned the place out and made sure that everything was pretty and put it back together so that the dust did not accumulate.
Q Now, when you say once a month, you're talking about -- are you talking about once a month in the shop or once a month for each piece of equipment?
A Once a month --
DEFENSE COUNSEL: Objection; misstates his testimony.
THE WITNESS: Once a month for each piece of equipment. You know, you had a regular schedule --

BY MR. PAUL:
Q Okay.
A -- that -- you know, and -- and you had a little book, you had to sign it saying, yeah, yeah, we did it.
And you open it up, clean it out, clean the air filters, if so --
Q Okay.
A You know, if it had an air filter in it, and basically make sure it was lubricated and cleaned, put it back together. As long as it was working, leave it.
DEFENSE COUNSEL: Move to strike nonresponsive portions.
BY MR. PAUL:
Q During the time you were on the Cambria, how many pieces of equipment were maintained or repaired using the vacuum cleaner system that you have described in the shop itself?
DEFENSE COUNSEL: Object to form, calls for speculation, misstates the witness's testimony.
DEFENSE COUNSEL: Lacks time and scope.

THE WITNESS: I can't really say. In the shop, I would say very little use of the vacuum cleaner in the shop, because we normally take it to the equipment, open the equipment up, vacuum it, clean it, whatever, and lubricate it, put it back together.
BY MR. PAUL:
Q You say -- you are talking about not in the shop but someplace else on the ship?
A That is correct.
Q Okay. All right. You mentioned the UR -- WRT-1 and the --
A Yes.
Q -- TED.
Tell me about those pieces of equipment.
A Well, WRT-1 is a transmitter, a low-frequency transmitter, which every ship, major ship, has one. It's basically the same size as the SRT, a little bit larger, again, specifically designed to transmit in low-frequency range as opposed to the high-frequency range.
It's a lot of tubes, slide-out drawers. You know, it's a pretty complex piece

of engineering, and it worked pretty good. Every once in a while, you know, a tube would go bad or something like that, but a pretty good piece of equipment really.
Q Okay. All right. I am going to -- sir, I am going to ask you to look at what has previously been marked as Plaintiffs' 12 and Plaintiffs' 14.
And let's go off the video while he goes through those.
THE VIDEOGRAPHER: Go off record at 9:51 a.m.
(Discussion off the record.)
(Plaintiffs' Exhibit 14 was marked for identification by the court reporter.)
THE VIDEOGRAPHER: We are back on record at 9:52 a.m.
BY MR. PAUL:
Q Okay. Sir, what -- what are you seeing in these pictures?
A This is an SRR-13 receiver.
Q Okay.
A And pretty much the way it's mounted on a ship in its own individual cabinet.

Q Why don't you hold that up to the -- to the jury can see it and point to it, what you're talking about.
Is that the top --
A Yeah, here.
Q -- one?
Okay. That's what it looks like?
A Yeah, basically.
Q All right.
A This thing is bolted or -- or, you know, in a -- on a table or a mounting of some kind. The picture here shows you how to get it out of the cabinet.
Q Okay.
A Just pick the handles up and hold them up and slide it out. Once you --
Q What would happen -- let's start -- what would happen when you would pull out the -- pull the piece out like that? What would happen, if anything?
A It comes out to -- to the end of the stop. It won't go any farther.
Q Okay.
A I mean, you know, you can leave it hang there, if you so desire.

Q Okay.
A But it -- it will tilt up and down so you can look at the top and the bottom, or you can push the buttons on the rail and take the whole thing out and take it to the shop and work on it if -- you know, if it's necessary.
Q Now, the bottom picture, that's when it's actually -- the whole thing is removed?
A Yeah. That -- that's how to take it --
Q Why don't you show that to the --
A -- off of the --
Q Show that to --
A -- off of the sliding rails.
Q Show that on the video, too, if you would.
A Yeah, right here.
Q Now, you mentioned dust before. Was there dust when you removed this, when you did this job?
A Well, normally this type of receiver, because it's built specifically for shipboard use, is fairly airtight. There has to be some circulation to let the heat get out, but normally the thing is cooled off with an internal fan and

an air filter.

One of the purposes of removing this thing, like it's shown here, is to get at the air filter and make sure it's clean air back in the back of the equipment or, you know, anything that's accumulated.

Q Okay. And, in fact, there was -- you personally recall seeing dust accumulated when these were removed?

DEFENSE COUNSEL: Object to form, leading.

BY MR. PAUL:

Q If I've -- if I'm stating correctly -- tell me if I'm stating correctly what you --

A Yes.

Q -- just said.

A There -- there were occasions when there were dust inside the equipment.

Q Okay.

A Yeah.

Q Now, was this unique to the SRR-13, or was that true generally?

DEFENSE COUNSEL: Object to form.

THE WITNESS: No, that's pretty much

generally every piece of equipment. The -- the amount of dust, dirt, crud, whatever you want to call it, that accumulated depended on the design of the equipment, how much air could actually get in from outside.

And like I said, normally these things are designed to prevent dust from getting in, but you can't make them totally dust-proof.

BY MR. PAUL:

Q Okay. Are these -- is this -- are most of these transmitters and receivers high temperature?

DEFENSE COUNSEL: Object to form; calls for speculation, vague.

THE WITNESS: In my opinion, yeah, you've got to watch out. Especially the tubes --

BY MR. PAUL:

Q Okay.

A -- you know, tubes are -- don't grab them until they cool down.

Q And each of these had -- the SRRs and some of these other pieces of equipment you have talked about --

A Yeah.

Q -- all had tubes in them?

A Yeah.

Q Okay. And they were hot to the touch, you say?

A Yes.

DEFENSE COUNSEL: Objection; leading.

(Plaintiffs' Exhibit 13 was marked for identification by the court reporter.)

BY MR. PAUL:

Q Okay. Turn to what's marked on the bottom as LMCKR 39. Do you see that one? It says "Section 4" on the top. "Section 4" on the top.

A 39? Oh, okay. Let me see here. 31 -- okay. Oh, 39. Okay.

Q Do you see it?

A Yeah.

Q Okay. What do we see here?

A Okay. This looks like removing parts from the internal of a receiver. On this upper picture, you can see the mechanical couplings here where the --

Q Can you hold it --

A -- outside dials and so forth --

Q Hold it this so way so the camera can

see it. Go ahead.

A This here?

Q Yeah.

A Okay. Once you get the -- the thing mechanically decoupled, you -- you can pull it out or, as shown in the bottom picture, you can take out a plug-in board.

Q Okay.

A Yeah. This one, the plug-in board there shows resistors, capacitors, whatever you want to call them, and the connecting pins so that they will hook into the -- the main chassis.

Q Can you show me or tell the jury which is the resistors and which are the capacitors in this picture, if you can see them?

A Yeah. Okay. On -- right here, this little darkish thing with the stripes on it, okay, is a resistor.

Q Okay.

A Okay? The stripes indicate the -- the particular resistance of the resistor.

Q Okay.

A The size of it indicates whether it's a half a watt, 1-watt, 2-watt, whatever.

Q Okay.

A The other 1, 2, 3 -- four little items shown here next to it appear to be capacitors.
Q Okay. Okay.
A Although, you know, I can't really see what it says on there, but it's -- it -- to me, it looks like capacitors.
Q Now, on the -- on the bottom, I guess, left there's a -- there's a little cartoon of a sailor.
A Yeah.
Q Is he basically holding the piece of equipment that we're talking about --
A Yeah, the --
Q -- the board?
A What he has in his left hand holding up is --
Q Show that to the jury, please.
A -- is the board that is shown as being removed here.
Q Okay.
A The -- in his right hand is the receiver where the board plugs into.
Q Okay. How often during your time on the Cambria did you see this operation go on?

A Quite a few times.
Q Okay.
A I would say -- well, let's see. I was there -- what was it? Three and a half years.
Q Right.
A Two and a half years? Whatever.
Q Before we go on to the next picture -- before we go on to the next picture, this -- the cartoon of the sailor -- okay?
A Yeah.
Q What, if anything, would -- would you -- did you see when this piece was removed?
DEFENSE COUNSEL: Object to form.
THE WITNESS: When -- when the board he's holding --
BY MR. PAUL:
Q Yeah.
A -- was removed?
Q Yeah. What, if anything, did you see?
A Well, you can -- you can in the main picture here --
Q Right.
A -- you can see down inside there's --

there's other components in there --
Q Okay.
A -- connectors, more capacitors, it looks like a resistor or two --
Q Okay.
A -- a couple of sockets for the thing to plug into.
Q Okay.
A And it's -- you know, the cartoon of the --
Q Right.
A -- of the sailor --
Q Right.
A -- shows it at basically an empty hole --
Q Right.
A -- which is -- that's not true. These things are built pretty tight.
Q Okay. Were -- was anything inside there that you saw frayed or worn?
DEFENSE COUNSEL: Objection.
THE WITNESS: Well, that's one of the reasons for taking the pin out, is to check for frayed and worn things. If you see something frayed and worn, you would take that module

that's shown there --
BY MR. PAUL:
Q Right.
A -- and probably go to the shop and see if you can replace the frayed or worn part.
Q Okay.
A Normally speaking, the only -- in -- in this subassembly here that's shown being pulled out, the only thing that would get frayed, worn, or broken is the pins itself on the bottom of the -- the assembly shown in -- being pulled out or, like I said, occasionally a tube bad or --
Q Okay.
A -- a resistor, whatever.
Q Allright. So there's a tube or a resistor in this particular piece of equipment?
A Oh, yeah. Yeah.
Q Now --
A It's not visible, but --
Q Okay.
A -- there is. Yes.
Q Now, in order to -- so we don't have to go through the same procedure with each of the

pieces of equipment you have mentioned so far and the ones we are going to talk about later --
A Yeah.
Q -- was the procedure that you follow used the same for all the different pieces of equipment of transmitters and receivers you've mentioned so far; there's nothing -- is there anything unusual or different about one or the other?
DEFENSE COUNSEL: Object to form, lacks foundation.
THE WITNESS: That -- that is true, yes. It's pretty much stand- -- again, depending on how the thing is built, but, you know, whether you've got a little one or a big one, it's -- it's pretty much the same thing.
BY MR. PAUL:
Q Did you ever see any dust in -- in this operation?
DEFENSE COUNSEL: Object to form.
BY MR. PAUL:
Q You had mentioned dust earlier, and you talked about --
A Yeah.
Q Was there dust in -- did you see dust

in these -- when this product was removed?
A Well, in this -- this particular --
DEFENSE COUNSEL: Objection; leading, lacks foundation, misstates prior testimony.
BY MR. PAUL:
Q Go ahead. You can answer.
A In this particular SRR-13 type of equipment, like I said, they're built pretty airtight. They -- they have a -- a fan to circulate air in them to cool them off. It has an -- an air filter in it, which, you know, you check and clean once every month or three, depending on the schedule. But as far as a lot of dust accumulating, I would say not a lot.
Q But some?
A Some, yeah.
DEFENSE COUNSEL: Objection; leading.
BY MR. PAUL:
Q All right. Let's go on to page 40.
A Okay. Page 40. Okay.
Q Is this an operation you have seen before?
A Yes. Yeah.
Q How often did -- did -- were plug-in units removed during your time on the Cambria?

A Quite often.
Q Okay.
A Because of, again, component failure. Most of the time, it was tubes.
Q Okay. Now, there is another cartoon, and the sailor -- can you describe what the sailor's doing or what you think he's --
A Well, yeah, he's -- he's got the thing over his head, shaking it, trying to get it out, but it --
Q Did that ever happen?
A No.
Q Okay.
A No. I mean, it's -- it's humorous, but it hardly ever happens.
Q All right.
A In the picture beside the sailor, you can see some of the subassemblies --
Q Right.
A -- are held in with a bar, which is turned to lock it in place.
Q Okay.
A You turn it crosswise and the assembly unplugs.
On the bottom picture, again, you can

see the assembly coming out and there is a cap- -- it looks like a capacitor, two or three capacitors. I don't see a resistor right off -- okay. Right up toward the -- the top, you can see the end of a resistor.
Q Why don't you point that out. Again, show that to the camera. Point that out.
A Right in here.
Q Okay.
A It -- like I said, it's hard to see.
Q Right.
A I assume it's a resistor as opposed to being a -- a coil or a capacitor or something.
Q Right.
A But you take those out, if there's something wrong you replace it, solder the replacement back in, plug it in, lock the wire in place, and it's held in place.
Q Okay.
A Yeah.
Q Now, let's -- let's go back to P-1 for a minute. That's the manual. Can you go back to the manual for a second?
A Oh, which one? This here?
Q The ET -- no, the ET --

A Oh, ET-3. Okay.
Q ET-3. If you go back to the ET-3 --
A Yeah.
Q Now, you mentioned soldering.
A Yeah.
Q And what I want to ask you about is one of -- if you turn to 1, 2, 3 -- the fourth page, it says page 367 on the bottom.
A Okay.
Q Do you see that?
A Yeah.
Q All right. And you see that I have previously marked a sentence that says, "After determining"?
Do you see that?
A Yeah, I see it. Yeah, that --
Q Okay. Can you read that into the record, please.
A Okay. "After determining that the heat" --
DEFENSE COUNSEL: Objection; form.
BY MR. PAUL:
Q Go ahead. You can answer the question.
A "After determining that the

heat-sensitive part is too close, place a shield (asbestos or like substance) between the parts before applying hot soldering iron, and place" sink -- "heat sink clamps on all leads from the heat-sensitive part."
Q Okay. Did you ever see --
DEFENSE COUNSEL: Move to strike, specul- -- move to strike, hearsay, lacks foundation.
BY MR. PAUL:
Q Did you ever physically do that?
A No.
Q Did other people around you do that?
DEFENSE COUNSEL: Object to form.
THE WITNESS: Not to my knowledge, no.
BY MR. PAUL:
Q Okay. All right.
A Because most -- in -- when you get down to the component level here, right --
Q Yeah.
A -- there was hardly any asbestos-type thing around.
The -- the hot soldering iron is chosen because it's the -- the right size that

you need for -- for desoldering and -- and resoldering equipment.
Q Okay.
A You know, like you don't take a hammer to drive a thumbtack.
Q Okay. Are you --
DEFENSE COUNSEL: Can I -- sorry. Can I have the answer read back, please.
(Record read.)
DEFENSE COUNSEL: Move to strike nonresponsive portions.
BY MR. PAUL:
Q Okay. Are you aware of any asbestos products in electronic equipment yourself?
DEFENSE COUNSEL: Object to form.
DEFENSE COUNSEL: Objection; lacks foundation.
THE WITNESS: Personally, no.
BY MR. PAUL:
Q Okay. Let's turn -- go to -- back to the manual, page 46, picture 46.
Now, I'll represent to you, sir, that this is from a navy -- a navy manual. You can see, at the top, it says, "NAVSHIPS 92977" --
A Yeah. That's right.

Q -- on the top.
What do we see in the page that's marked 46?
A It's an SRR-13 receiver --
Q Right.
A -- being pulled out of its case.
Q Right.
A And the latching mechanism has been released so that you can tilt it down to look at the -- the top of the equipment and back into the case itself to the -- the jack where the cable test hooks into.
Q Okay.
A On the SRR-13, the cable indicated here in this picture plugs into the back of the case and then into the back of the equipment so that the equipment can be operated while it's in the open position. Normally, this cable is not in there. When you remove this cable, the equipment is -- it's dead.
Q Okay.
A Once you tilt it back up and slide it back in, the connector on the back of the receiver connects with the J-1809 in the case and energizes everything.

and all the parts and so forth you need.
Q Okay. Was -- was he, therefore, in the vicinity of you and the other men working for you? Was that his job, to be in your vicinity while that was going on?
DEFENSE COUNSEL: Object to form.
DEFENSE COUNSEL: Objection; form.
THE WITNESS: He did not have to be there while we were working, but he was -- you know, he would come in, check, see how we're doing while we were working --
BY MR. PAUL:
Q Okay.
A -- and then go somewhere else and check on whatever.
Q Okay.
A Or grab a cup of coffee, whatever.
Q Okay.
A He did not have to be there while we were working is --
Q Right.
A -- is the point I'm trying to make.
Q Right.
A He was there.
Q Okay?

A But he didn't have to be there --
Q Would you say --
A -- all the time.
Q Right. Would you say he was there occasionally or --
A Frequently.
Q Frequently?
A Yeah.
Q Okay. Are you able to tell me how frequently he was in the shop with you, if you're able to?
A I would say in a normal eight-hour day when nothing much was happening he would come into the shop three times --
Q Okay.
A -- a day.
Q Three times a day?
A Yeah. Just to check and see how things were going, what's -- you know, what's the latest --
Q Right.
A -- that type thing.
Q What kinds of equipment were stored in the shop?
A The only equipment that was stored in

the shop were small pieces of test equipment, spare components that we had in the -- in cabinet drawers.
Q Okay.
A And the coffeepot.
Q That's key, I agree.
Any -- you mentioned resistors. You have talked about resistors and capacitors before.
A Yeah.
Q Did you have spare ones in the shop that you used or --
A Yes, we did.
Q Okay. Anything else?
A We had -- oh, let me see. We had quite an assortment of hardware, nuts and bolts and things like that. We also had spare resistors, spare capacitors. We -- we can't stock everything that's in use everywhere, because we didn't have the space.
Q Okay.
A But we did have commonly used resistors and capacitors stored in the -- in the shop.
Q Okay.

A So if we needed, you know, a 220K ohm resistor, we -- yep, okay, we've got one.
Q Okay.
A If we didn't have one, we went to supply and ordered one out of --
Q Okay.
A -- down below.
Q Okay. Were you and the men that worked for you and Lieutenant Kraus required to work outside of the shop?
A Yes. Quite frequently we would --
Q Okay.
A -- work in the transmitter room, the receiver room, wherever the equipment was located.
Q Okay.
A We didn't do any major repairs --
Q Okay.
A -- in the receiver room, transmitter room.
Q Okay.
A We would -- if we had something major that we had to work on, we would take the -- the subassembly, the component out of the transmitter, receiver, whatever, take it to the

Q Okay. When you say they weren't great, what does that mean?
A I mean they -- no trouble, they just kept working. Every once in a while --
DEFENSE COUNSEL: Did you say they --
THE WITNESS: -- you find a burned-out tube, but, you know, that's easy enough to diagnose and replace and it goes back to service.
BY MR. PAUL:
Q Okay. All right.
DEFENSE COUNSEL: I'm sorry, can you read back the -- his first answer.
(Record read.)
DEFENSE COUNSEL: Did you mean worked --
DEFENSE COUNSEL: Did you say they worked great or they weren't great?
THE WITNESS: What? The AM-1365?
DEFENSE COUNSEL: Yes.
THE WITNESS: Beautiful piece of equipment. Great.
DEFENSE COUNSEL: They worked great?
THE WITNESS: They worked great.
DEFENSE COUNSEL: Thank you.

BY MR. PAUL:
Q Okay. All right. Okay. Did we talk about the WRT-1 and 2? Are you familiar with those two pieces?
A Yes, I am. WRT-1 --
Q Tell me about --
A -- is a low-frequency transmitter. A WRT-2 is an HF, high-frequency transmitter.
Q Okay.
A I believe they're 100 watts or something like that, output. Monsters to work on, because they're large, heavy, bolted in place, modular. You know, you have to open the thing up and pull the modules out if -- in order to replace anything.
Q And how -- was that a hard job to replace the modules?
A No. No, the -- all the equipment -- all the navy equipment is made to slide out and -- and, you know, sometimes you tilt it up and down, sometimes you can tilt it side to side --
Q Okay.
A -- in order to get access to all the

modules, because they put it into small spaces. It's not like, you know, you can walk around behind it or, you know, up on either side of it, because there's another one sitting right there.
Q Okay. All right. So let me just see if we've -- we've covered the SRR-13, the SRT -- the SPS-40, the SRT-17, the R-390, the R-1051, the SRR-11, the SRT-16, the SRR-13, the SPS-8, the UPX-12, the SPA-4, the SPS-8, the AM-1365, the WRT-1 and 2, the R -- WRC-1, okay, the SPS-10, the SPS-10E, the SPA-8, and the SPS-4. We've talked about all those?
A Yeah. I think -- the one thing you mentioned, and I think you have it in there twice --
Q Yeah.
A -- is the SPS-8.
Q Right.
A There was no SPS-8, to my recollection. I think --
Q Okay.
A -- that might be a misspelling of the SPA-8.
Q Okay. Okay. I've got it. All

righty. And --
Go off the record for a minute.
THE VIDEOGRAPHER: We're off record, 11:08 a.m.
(Discussion off the record.)
THE VIDEOGRAPHER: We are back on record at 11:09 a.m.
BY MR. PAUL:
Q Did we go over the SRR-11?
A Yes.
Q We did. Okay. All right. Now, in preparation for this deposition, did you prepare two documents?
A Did I prepare any documents?
Q Yes. Did you -- well, did you write me a letter?
A Oh, yeah. Okay.
Q Okay.
A You sent me a letter asking me if I was the Roger Gossett on the ship.
Q Right.
A I answered back saying yes, I am.
Q Right.
A And -- and then you sent me another letter to set up this meeting that we're at now.

Q Okay. And what was he doing?
A What was he doing?
Q Yeah. When you saw him working on it, what was he doing?
A Oh. Well, there were a couple of times when it, you know, wasn't putting -- transmitting as it should, and I believe he had something to do with the power amplifier output to, you know, replace the -- the tube or -- or something along that line.
Q Okay.
A And the rest of -- oh, he also -- at one time, he had to check the sensitivity of it, because the radiomen were complaining, you know, we can't hear anybody on the receive side.
Q Okay.
A And it turned out that they had their ears plugged.
Q Okay. Was -- okay. Is this a high-temperature product? Did it generate high temperatures?
A It did internally, but like I said, we were discussing the heat --
Q The heat sinks.
A -- sinks, yeah, it --

Q Dissipated the heat?
A It took care of it, dissipated it out into the room.
Q Okay.
A And there was plenty of ventilation in the room.
Q Okay. Okay. Were there -- do you know, one way or the other, if there were other Collins radio products on the ship, other than this particular product, if you know?
DEFENSE COUNSEL: Asked and answered.
THE WITNESS: I don't know.
BY MR. PAUL:
Q Okay. Do you associate any products with the name Admiral on the ship?
A No.
Q Then I have nothing further.
Let's go off the video.
MR. LeJEUNE: I don't have anything further.
THE VIDEOGRAPHER: We're off record at 2:21 p.m.
(Discussion off the record.)
THE VIDEOGRAPHER: We are back on record at 2:25 p.m.

EXAMINATION
BY MS. RAPPAPORT:
Q Hello, sir. My name is Nancy Rappaport, and I represent Northrop Grumman Corporation.
I'm just going to ask you, like I said, a few questions for clarification on a few different pieces of equipment that you mentioned --
A Okay.
Q -- in your earlier testimony.
You had testified earlier, and tell me if I -- if I got this wrong, that the WRT-1 was -- and you called it a monster to work with because it was large and heavy. Is -- is that one of the pieces of equipment that you said was so large that you could only have so many people around it or in the room when it was being worked on?
A The WRT-1?
Q Yes.
A Yeah. It's -- normally the WRT-1 was installed in the transmitter room with other transmitters to either side of it. And onboard ship they don't have a lot of space, so they cram

things together and, you know, it's -- if I remember correctly, the WRT-1 was standing side by each with the other transmitters.
Q So is it fair to say that that is one of the pieces of equipment that you would not have seen Mr. Kraus around when it was being repaired or maintained?
A Well, if -- if somebody is working on a piece of equipment, okay, let's say that the guy is doing -- working on a WRT-1 or any other piece, okay, and it's going to take him two hours, Mr. Kraus might have been there for five or ten minutes of that two hours. So I cannot specifically say yes or no, he was there or he was not there. There was a good probability that he was there some of the time.
Q But you don't specifically recall seeing him present when a WRT-1 was being worked on?
A That is true.
Q Okay. And is it also fair to say that you don't specifically recall seeing Mr. Kraus present when a WRT-2 was being worked on as well?
A That is correct.

Q Did Mr. Kraus ever provide any safety training?
A No, not to my knowledge or recollection.
Q That's all the questions I have, sir. Thank you so much.
A Thank you.
(Plaintiffs' Exhibit 19 was marked for identification by the court reporter.)

FURTHER EXAMINATION
BY MR. PAUL:
Q Okay. I am going to show you what's previously been marked as P-19.
Reporter, hand it up to the witness.
Anything in there look familiar to you, on that page look familiar to you?
A Oh, yeah. GRC-27, yeah.
Q Okay. You remember the GRC-27. Anything else?
A Well, the -- now I know what an AM-1365 is.
Q Okay. What is an AM-1365?
A It's an amplifier that goes on the

end of a UHF transmitter, T-E-D, TED.
Q Okay. What's TED -- what does TED mean?
A It's one of the old navy designations, T for transmitter, E for electronic, and D for device.
Q Okay. So it's attached so the -- the amplifier is attached to this device?
A No.
DEFENSE COUNSEL: Objection; leading.
THE WITNESS: You've got a TED --
BY MR. PAUL:
Q Okay.
A -- sitting here this big.
Q Okay.
A And the amplifier, if you have one, is sitting on top of it.
Q Oh, it's on top of it.
A The output of the TED goes into the amplifier, and it puts -- the TED puts out 10 watts.
Q Okay.
A The amplifier boosts that up to 50 or 100, whatever it is.
Q Okay. All right. Do you -- now that

you have seen this, do you have any recollection of seeing that particular piece of equipment being worked on? And, again, I'm referring to the AM-1365.
A No. It's one of those that just sit there and works.
Q All right. Thank you, sir. I have nothing further. You can pass that back.

FURTHER EXAMINATION
BY MS. RAPPAPORT:
Q Sir, did you ever see an AM-1365 being worked on during the overhaul?
A No.
Q Do you recall seeing any equipment being worked on during the overhaul on the ship --
A As far --
Q Actually, strike that.
A No, because --
Q Strike that, because you already -- you already answered it. Forget it.
A Okay.
Q Thank you.

MR. PAUL: All right. Let's go off the video.
THE VIDEOGRAPHER: Off record at 2:34 p.m.
(Discussion off the record.)
THE VIDEOGRAPHER: We are back on record at 2:37 p.m.

EXAMINATION
BY MS. DEZII:
Q Good afternoon, sir. My name is Dawn Dezii. I represent Belden. How are you?
A I'm doing fine. Thank you.
Q It's a mighty big stick.
A Oh, yeah. Got to have it.
Q Is that walk softly and carry a big stick?
A Okay.
Q Okay. I want to start with some general questions just to get some things out of the way, and then we'll jump into the meat of it. I will go as quickly as I possibly can.
You talked about being -- you talked about some new cable being installed on the

EXHIBIT C

Report of MATERIAL INSPECTION

of U.S.S. CAMBRIA (APA-36) conducted 3-4 JANUARY 1963

by SUB-BOARD OF INSPECTION AND SURVEY, NORFOLK

type ATTACK TRANSPORT ; overall length 492 feet;

beam 70 feet; FULL LOAD displacement 13,194 tons; SINGLE screw(s);

8500 shaft horsepower; GEARED TURBINE drive;

authorized under PUBLIC LAW 665 OF 77th CONGRESS ; constructed by

WESTERN PIPE AND STEEL CO. at SAN FRANCISCO, CALIF.;

preliminarily accepted NOVEMBER 1943 ; first commissioned 10 NOVEMBER 1943;

periods of inactivation, immobility or non-naval service MAY 1949 - SEPT 1950

; latest recommissioning or reactivation 15 SEPT. 1950

last regular overhaul 1 AUGUST 1960 - 20 SEPT '60; last docking 22 AUG '60 - 9 SEPT '60 ;

recent repair availabilities 27 APRIL 1962 - 11 MAY 1962 ; days underway

since last overhaul 171 ; days not underway since last overhaul 573 ;

prospective date of next overhaul 3 MAR 1963; last INSURV inspection 23 NOV 1959 ;

status ACTIVE ; Fleet assignment PHIBLANT

EXHIBIT P9

Enclosure (1)

BUREAU OF SHIPS (ELECTRONICS)

"A" - URGENT REPAIRS RECOMMENDED:

(1er) Eliminate shock hazard of LM-21 frequency meter.

(2er) Replace all missing ground straps and braid straps with copper straps. Check all remaining straps to insure metal to metal contact. Insure all electronics equipment is grounded IAW BuShips Instr. 9670.16 and general Specs for Navy Ships S67-0-D.

(2.1er) Replace ungrounded test equipment plugs with grounded plugs and three conductor cords. (BSTM 62).

(3er) Overhaul radio antenna system. Most antennas have unsatisfactory insulation resistance.

(4er) Repair AN/SPS-10B.

a. AFC inoperative
b. Set control lights inoperative.
c. Defective meter selector switch.
d. Crystal current CR-2 low
e. Substandard MDS and ring time.

(5er) Repair inoperative VK-5 repeater, sweep chassis inoperative.

(6er) Repair inoperative AN/SRC-27 #1 antenna open.

"B" - DESIRABLE REPAIRS RECOMMENDED:

(7er) Replace transmission line on AN/URT-7 #2 One megohm insulation resistance.

(8er) Replace defective blower motor in TED #3.

(9er) Replace defective coil in speaker #4 in Flag Plot.

(10er) Correct antenna insulation resistance of 6 megohms of AN/SRT-16 left.

(11er) Repair inoperative LR-2 frequency meter.

(12er) Repair defective IPA in AN/SRT-14 ##.

(13er) Repair AN/SRT-14 #5. Defective modulator drawer,

"C" - REPAIRS REQUESTED BUT NOT RECOMMENDED: None

"D" - ALTERATIONS RECOMMENDED AS:

(Class A): (Alterations of Urgent Military Necessity or of Utmost Importance and Immediate Urgency:)

None

(Class B): (Alterations Less Urgent Than Class A:)

None

(Class C): (Desirable Alterations:)

(4Øer) Modify installation to permit remote dialing of AN/GRC-27 #2 and #3.

(41er) Take action to have the following test equipment not on board, not on allowance but needed for POMSEE added to the allowance list:

AN/UPM-55	Model 8ØSA Slotted Line
AN/USM-27	Model 415C Standing Wave Indicator
AN/USM-38	Model 43ØC Microwave Power Meter
AN/USM-3Ø	Model 477B Coaxial Thermistor Mount
AN/URM-82	FR-7/UP Echo Box
FR-4/U	AN/GPM-1S
DA-2ØØ/U	AN/USM-26

"E" - ALTERATIONS REQUESTED BUT NOT RECOMMENDED: None

"F" - ITEMS OUTSTANDING:

(42er) Accomplish the following field changes:

Equipment	Serial No.	Field Change No.
AN/21S/U	92, 78, 87, 98	1
PP-765A/U	174, 177	1
AN/SRT-14	393, 775, 745	
	771, 298	11, 13
AN/SRT-15	293	1Ø, 12, 15, 17
AN/SRT-16	4Ø1, 4Ø3	1Ø, 12, 15, 17
TCS-9	1335	8
TCS-12	16321, 11769, 13853	2, 3, 6, 8, 9, 1Ø
TED-1	276, 287, 298	3
TED-3	4Ø2	3

Equipment	Serial No	Field Change No.
TED-5	939, 919, 925	
	9Ø9, 888, 878	3
TED-7	583	3
R-39ØA/URR	69Ø, 395, 652	2
AN/SRC-27A Remote	1499, 5735	1
AN/URC-32	218	3, 4, 5, 6, 7, 9
RBO	3199, 493Ø, 2637	3
AN/SPA-4A	954, 1144	1Ø
AN/SPA-8A	1332, 1323	13, 14
O-329/SP	328	1
AN/SPS-1ØB	146	2
AN/UQN-1C	514	1, 2, 7
AN/UPM-7Ø	421	1, 2, 3
AN/USM-32	429, 1719, 2125	1
TV-3C/U	18Ø2, 1939	2
TV-1ØA/U	655, 825	2

(43er) The following ShipAlts are outstanding:

APA-8ØØ	Replace VJ's with AN/SPA-4A radar repeaterd.
APA-961	Install additional remotes in Radio 1
APA-923	Relocate 5 MF/HF Receivers from Radio 1 to SAAC
APA428	Extend RBO System
APA-989	Facsimile Equipment
APA-981	Improve Antenna system
APA-986	Teletype Tape Facilities
APA-982	LF/MF Radio Equipment
APA-983	SSB Radio Equipment
APA-991	Automatic off-line Crypto (AN/SGA-3)
APA-98Ø	On-line Security Equipment
APA992	Install improved ECM Equipment AN/WLR-1)
APA-973	AN/UNQ-7 Recorder
APA-95Ø	Loran "C" Converter
APA-984	Improved Air Search Radar (AN/SPSA4Ø)

NAVSHIPS 4661 (REV. 1-63)

SHIP ALTERATION MATERIAL SUMMARY

TO	SHIP	OVERHAUL PERIOD
Commander, Philadelphia Naval Shipyard	USS CAMBRIA (APA-36)	4-1-65 RESTRICTED AVAILABILITY

APPR.	SHIPALT	BRIEF OF SHIPALT AND EQUIP. DESCR.	QTY.	MILSTRIP/REMARKS
		AN/WLR-3 ECM Equipment	1	08681503290l7 to NSY NORVA directs local release.
		AS-899A/SLR Direction Finding Antenna	1	0868150329036 to NSY NORVA directs local release.
		C-1609/SLR Control Unit	1	0868150329040 to NSY NORVA directs local release.
		AM-1017 ECM Amplifier	1	0868150329039 to NSY NORVA directs local release.
		AS-571/SLR Antenna	1	0868150329037 to NSY NORVA directs local release.
		AS-616A/SLR Direction Finding Antenna	1	08681-50329038 to NSY NORVA directs local release.
	APA-1003	AN/SPA-4D Radar Display	1	08681442459023 to NSC NORVA directs shipment to NSY NORVA.
	APA-1004	UHF RADIO EQUIPMENT		
		AN/SRC-20 Transceiver	3	(3) AN/GRC-27A On board, retain.
		TED Transmitter	11	On board, retain.
		AM-1365/URT RF Amplifier	6	0868151049045 to NSC NORVA directs shipment to NSY PHILA.

NAVSHIPS 4661 (REV. 1-63)

SHIP ALTERATION MATERIAL SUMMARY

TO	SHIP	OVERHAUL PERIOD
Commander, Philadelphia Naval Shipyard	USS CAMBRIA (APA-36)	4-1-65 RESTRICTED AVAILABILITY

APPR.	SHIPALT	BRIEF OF SHIPALT AND EQUIP. DESCR.	QTY.	MILSTRIP/REMARKS
		AN/SRA-12 Filter Assembly	3	(4) On board, retain.
		AN/SRA-17 Antenna Tuning Group	4	0868142459024 to NSC SDIEGO directs shipment to NSY NORVA.
		AN/SRA-16 HF Multicoupler	1	0868142459003 to NSC NORVA directs shipment to NSY NORVA.
		CU-691/U UHF Multicoupler	3	0868142459026 to NSY NORVA directs local release.
		CU-692/U UHF Multicoupler	1	0868142459025 to NSC NORVA directs shipment to NSY NORVA.
	APA-982	LF/MF Radio Equipment		
		AN/WRT-1A Transmitter	2	0868142459030 to NSY NORVA directs local release.
		AN/WRR-3 Receiver	3	Material not available this overhaul.
	APA-983	SINGLE SIDEBAND EQUIPMENT		
		AN/URC-32 Transceiver	2	On board, retain.
		AN/WRT-2 Transmitter	4	0868142459027 to NSY NORVA directs local release.

EXHIBIT D

PRINCIPAL COMPONENTS AND PHYSICAL DATA (cont'd)

COMPONENT	QTY	HEIGHT (Inches)	WIDTH (Inches)	DEPTH (Inches)	UNIT WT. (Pounds)
VK-5					
Azimuth-Range Indicator ID-226/SP	1	42-5/32	22	21-15/16	471
Power Supply PP-734A/SP	1	24-3/16	23-7/8	13-7/8	145

REFERENCE DATA AND LITERATURE

Technical Manuals:
- NAVSHIPS 900986 (VK)
- NAVSHIPS 91300 (VK-2)
- NAVSHIPS 91413 (VK-3)
- NAVSHIPS 91563(B) (VK-4)
- NAVSHIPS 91910 (VK-4a)
- NAVSHIPS 91786 (VK-5)

Note 1. Federal Stock Numbers

VK - F5840-644-4631
VK-2 - F5840-642-8346
VK-3a -
VK-3 - F5840-260-4622
VK-4 - F5840-644-4635
VK-4a - F5840-665-3812
VK-5 - F5840-644-4629

Note 2. Manufacturers

VK, VK-3, -3a - General Electric Company
VK-2 - Hazeltine Electronics Corporation
VK-4, -4a, -5 - Westinghouse Electronic Corp.

Radio-Transmitter

TRANSMITTING SET, RADIO AN/WRT-2(XN-1)

FUNCTIONAL DESCRIPTION

The AN/WRT-2(XN-1) Radio Transmitting Set is a high frequency transmitter designed for shipboard use on either surface or undersurface ships. The transmitter may be continuously tuned through its assigned frequency range and is capable of supplying a peak output power of at least 500 watts into a 50 ohm resistive load with a SWR of 4:1 or better.

No field changes in effect at time of preparation (9 June 1958).

ELECTRICAL AND MECHANICAL CHARACTERISTICS

FREQUENCY DATA: 1.5 to 30 mc.
TYPE OF EMISSION: A1, A3, F1.
POWER OUTPUT: 500 W.
POWER REQUIREMENTS: 115/220/440 v, 60 cps, 3 ph, 3 kva.

MANUFACTURER'S OR CONTRACTOR'S DATA

Westinghouse Electric Corp; Baltimore, Maryland.

Contract NObsr-71092.

TUBE AND/OR CRYSTAL COMPLEMENT

(2) OA2WA	(1) 5R4WGB
(4) WN5051C	(1) 5651WA
(15) 12AT7WA	(12) 6AL5WA
(8) 3B28	(1) 6J6WA
(4) 4X250B	(2) 5933WA
	(1) 6080WA

Total Tubes: (51)

(2) 1N100	(55) 1N198

Total Tubes: (57)

REFERENCE DATA AND LITERATURE

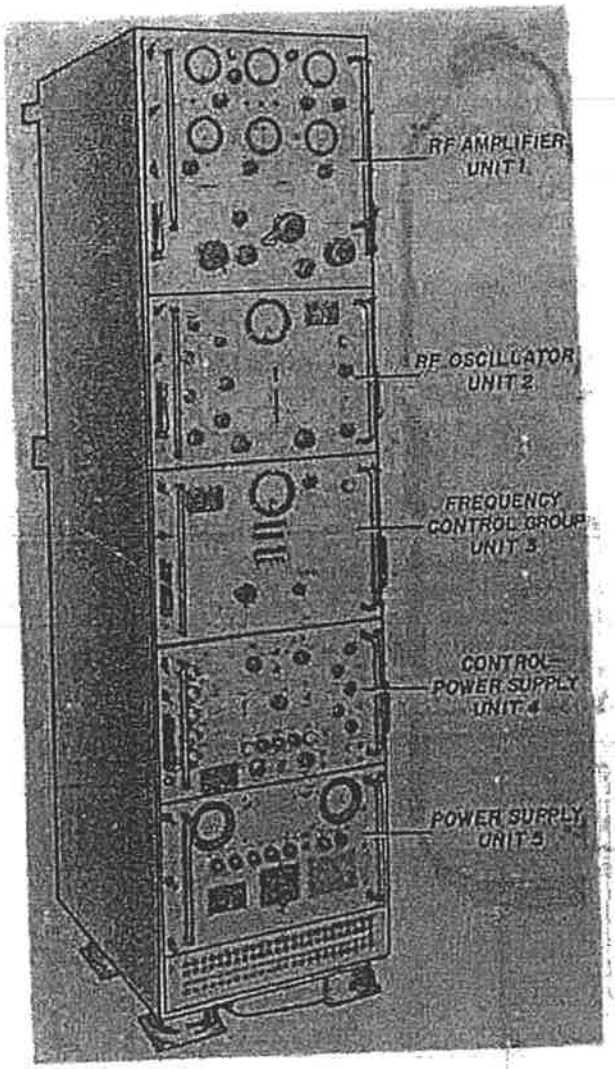
Nomenclature Card for Transmitting Set, Radio AN/WRT-2().

TYPE CLASSIFICATION
DESIGN COGNIZANCE BUSHIPS
PROCUREMENT COGNIZANCE
STOCK NO.

EQUIPMENT SUPPLIED DATA

QUANTITY PER EQUIPT	NAME AND NOMENCLATURE	OVERALL DIMENSIONS (inches)	WEIGHT (lbs.)
1	Radio Transmitting Set, AN/WRT-2(XN-1)	18 x 24 x 72	950

RADIO TRANSMITTING SET AN/WRT-2(XN-3)



Radio Transmitting Set AN/WRT-2(XN-3)

FUNCTIONAL DESCRIPTION

The AN/WRT-2(XN-3) is designed as a communication unit for installation aboard surface and undersurface vessels. The transmitter is tuneable through the frequency range of 2.0 to 30.0 megacycle (MC) and is capable of delivering a nominal average power output of 500 watts and a peak envelope power of 1000 watts into a 50 ohm resistive load with a standing wave ratio of 4:1 or better.

The Radio Frequency Oscillator, Unit 2 of AN/WRT-2(XN-3) is identical to Radio Frequency Oscillator, Unit 2 of AN/WRT-2(XN-4) except for the addition of a Voice Unit Meter and associated push-button controls on the front panel.

The Frequency Control Group, Unit 3 of AN/WRT-2(XN-4) differs from the Frequency Control Group, Unit 3 of AN/WRT-2(XN-3) in that a one megacycle Crystal Oscillator and a 10:1 frequency divider is used in lieu of a 100 kilocycle crystal oscillator as a standard frequency generator.

The Radio Frequency Amplifier, Unit 1 of AN/WRT-2(XN-4) differs from Radio Frequency Amplifier, Unit 1 of AN/WRT-2(XN-3) in that the first driver amplifier and the mixer circuits are redesigned.

No field changes in effect at time of preparation (15 April 1959).

RELATION TO OTHER EQUIPMENT

The AN/WRT-2(XN-3) is similar in operation to the AN/WRT-2(XN-4); but are not electrically and mechanically interchangeable.

EQUIPMENT REQUIRED BUT NOT SUPPLIED

(1) Antenna Tuning Group AN/SRA-18 to provide for manually (remote) matching the antenna to the R.F. output line of Radio Transmitting Set AN/WRT-2(XN-3) or (XN-4), (1) Antenna for R.F. Radiation, (1) Handset (carbon) type H-51/U or equivalent for local voice transmission. OPTIONAL EQUIPMENT AS REQUIRED BY THE PARTICULAR INSTALLATION, (4) Radiophone Unit type C-1138/UR Hand Key N.T. 26012, Teletypewriter (and auxiliary equipment) type TT-47/UG, Machine Telegraph Equipment, Antenna Radio Frequency TN-229/SRT, Antenna Coupler type CU-372/SRT, Retractable Mast Antenna Radio Frequency TN-230/SRT, Fairwater Radio Frequency Tuner TN-248/SRT.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

TYPE OF EMISSION: A1, A3, A3a, A3b and F1.

TYPE OF CONTROL: Frequency control in transmitting set is accomplished by phase-comparison circuits in conjunction with interpolation.

POWER OUTPUT.

CW OPERATION: 500 W average under locked-key conditions.

FSK OPERATION: 500 W average power.

A3 PHONE EMISSION: 500 W average power w/100% square wave modulation.

SINGLE SIDEBAND (A3a) OPERATION: One kilowatt peak envelope power, two-tone modulation.

INDEPENDENT SIDEBAND (A3b): One kilowatt

AN/WRT-2(XN-3) RADIO TRANSMITTING SET

peak envelope power distributed proportionally between upper and lower side bands.

AMBIENT TEMPERATURE: 0° C to +50° C.

RELATIVE HUMIDITY: Any up to 95%.

FREQUENCY STABILITY: Over a four-hour period, the equipment has a frequency stability of ±1 part in 10^7 parts of nominal operating frequency when operating at I kc lock-in points and at nominal line voltage and frequency in an ambient temperature range of +40° F to +90° F and relative humidity of 40 to 90%.

OPERATING POWER RQMT: 115 v, 220 v or 440 v, 60 cps, 3 ph.

MANUFACTURER'S OR CONTRACTOR'S DATA

Westinghouse Electric Corp, Baltimore, Maryland.

Contract NObsr-71092, dated 25 November 1955.

Approximate Cost: $312,436.00 with equipment spares.

TUBE AND/OR CRYSTAL COMPLEMENT

(8) 3B28	(1) 5R4WGB	(12) 6AU6WA
(15) 12AT7WA	(2) 0A2WA	(1) 6J6WA
(4) 4X250B	(1) 5651WA	(2) 5933WA
(2) 6080WA	(2) 2N188	

Total Tubes: (50)

(37) 1N198 (2) 1N100

Total Crystals: (39)

REFERENCE DATA AND LITERATURE

NAVSHIPS 93050(A): Technical manual for Radio Transmitting Set AN/WRT-2(XN-3) and Radio Transmitting Set AN/WRT-2(XN-4).

TYPE CLASSIFICATION
DESIGN COGNIZANCE BUSHIPS
PROCUREMENT COGNIZANCE
STOCK NO.
R.D.B. IDENT. NO.

SHIPPING DATA

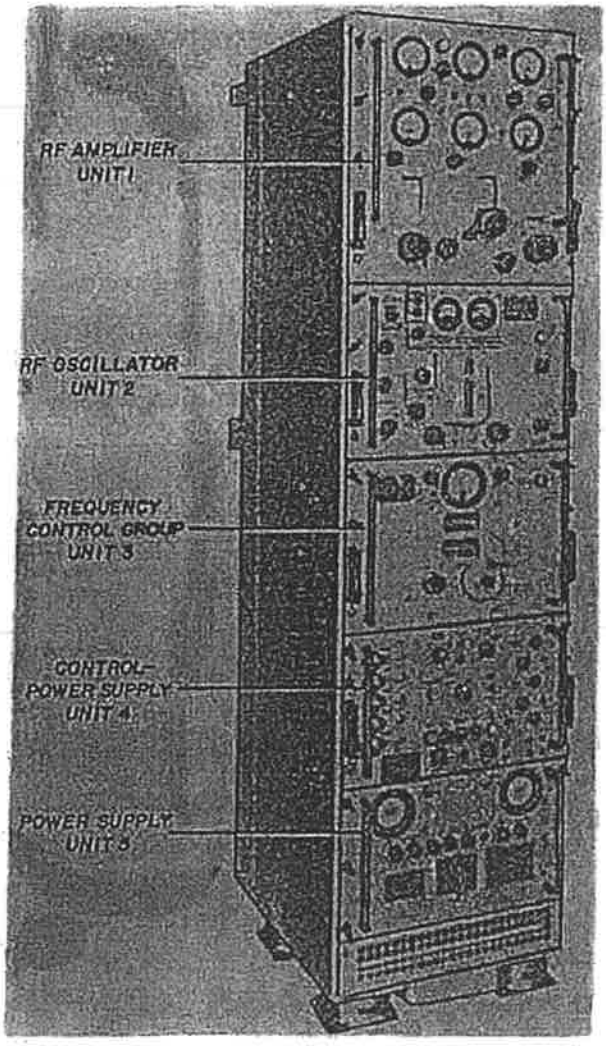
NUMBER OF BOXES	CONTENTS AND IDENTIFICATION	VOLUME (Cu.Ft.)	OVERALL DIMENSIONS (Inches)	WEIGHT PACKED (lbs.)
1	Radio Transmitting Set AN/WRT-2(XN-3) Incl: (1) R.F. Amplifier Unit 1 of AN/WRT-2 (XN-3) (1) R.F. Oscillator Unit of AN/WRT-2 (XN-3) (1) Frequency Control Group Unit 3 of AN/WRT-2(XN-3) (1) Control Power Supply Unit 4 of AN/WRT-1, 2, (XN-1) (1) Power Supply Unit 5 of AN/WRT-1, 2, (XN-1)	35.3	23-1/2 X 33 X 78-1/2	1130
4	Set of Equipment Spares	4.5	15 X 20 X 26	140

EQUIPMENT SUPPLIED DATA

QUANTITY PER EQUIPT	NAME AND NOMENCLATURE	OVERALL DIMENSIONS (inches)	WEIGHT (lbs.)
1	Radio Transmitting Set AN/WRT-2(XN-3)	18 X 28 X 71-11/16	950
1	Connector AN3106A-32-8P		3/10
1	Connector AN3106A-24-28P		1/5
3	Connector UG-88/U		
2	Connector UG-573/U		1/10
1	Connector UG-572/U		1/10
1	Packing List Maintenance Prints	1 X 9 X 12	1
1	Technical Manual NAVSHIPS 95050(A)	1 X 9 X 12	1-1/2
4	Set of Equipment Spares	15 X 20 X 26	140
1	Modification Kit		1

Radio-Transmitters

RADIO TRANSMITTING SET AN/WRT-2(XN-4)



Radio Transmitting Set AN/WRT-2(XN-4)

FUNCTIONAL DESCRIPTION

The AN/WRT-2(XN-4) is designed as a communication unit for installation aboard surface and undersurface vessels. The transmitter is tuneable through the frequency range of 2.0 to 30.0 megacycles (MC) and is capable of delivering a nominal average power output of 500 watts and peak envelope power of 1000 watts into a 50 ohm resistive load with a standing wave ratio of 4:1 or better.

The Radio Frequency Oscillator, Unit 2 of AN/WRT-2(XN-3) is identical to Radio Frequency Oscillator, Unit 2 of AN/WRT-2(XN-4) except for the addition of a Voice Unit Meter and associated push-button controls on the front panel.

The Frequency Control Group, Unit 3 of AN/WRT-2(XN-4) differs from the Frequency Control Group, Unit of AN/WRT-2(XN-3) in that a one megacycle Crystal Oscillator and a 10:1 frequency divider is used in lieu of a 100 Kilocycle Crystal Oscillator as a Standard Frequency Generator.

The Radio Frequency Amplifier, Unit 1 of AN/WRT-2(XN-4) differs from Radio Frequency Amplifier, Unit 1 of AN/WRT-2(XN-3) in that the first driver amplifier and the mixer circuits are redesigned.

No field changes in effect at time of preparation (15 April 1959).

RELATION TO OTHER EQUIPMENT

The AN/WRT-2(XN-4) is similar in operation as the AN/WRT-2(XN-3); but is not electrically or mechanically interchangeable.

EQUIPMENT REQUIRED BUT NOT SUPPLIED

(1) Antenna Tuning Group AN/SRA-18 to provide for manually (remote) matching the antenna to the R.F. output line of Radio Transmitting Set AN/WRT-2(XN-3) or (XN-4), (1) Antenna for R.F. Radiation, (1) Handset (carbon) type H-51/U or equivalent for local voice transmission. OPERATIONAL EQUIPMENT AS REQUIRED BY THE PARTICULAR INSTALLATION, (4) Radiophone Unit type C-1138/UR Hand Key N.T. 26012, Teletypewriter (and auxiliary equipment) type TT-47/UG, Machine Telegraph equipment, Antenna Radio Frequency TN-229/SRT, Antenna Coupler Type CU-372/SRT, Retractable Mast Antenna Radio Frequency TN-230/SRT, Fairwater Radio Frequency Tuner TN-248/SRT.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

TYPE OF EMISSION: A1, A3, A3a, A3b and F-1.
TYPE OF CONTROL: Frequency control in the transmitting set is accomplished by phase-comparison circuits in conjunction with interpolation.
POWER OUTPUT
CW OPERATION: 500 W average under locked-

Radio-Transmitters

AN/WRT-2(XN-4) RADIO TRANSMITTING SET

Key conditions.
FSK OPERATION: 500 W average power.
A3 PHONE EMISSION: 500 W average power w/100% square wave modulation.
SINGLE SIDEBAND (A3a) OPERATION: 1 kilowatt peak envelope power-two-tone modulation.
INDEPENDENT SIDEBAND (A3b): 1 kilowatt peak envelope power, distributed proportionally between upper and lower side bands.
AMBIENT TEMPERATURE: 0° C to +50° C.
RELATIVE HUMIDITY: Any up to 95%.
FREQUENCY STABILITY: Over a four-hour period, each equipment has a frequency stability of ±1 part in 10^7 parts of nominal operating frequency when operating at 1 kc lock-in points and at nominal line voltage and frequency in ambient temperature range of +40° F to +90° F and relative humidity of 40 to 90%.
OPERATING POWER REQT: 115 v, 220 v or 440 v, 60 cps, 3 ph.

MANUFACTURER'S OR CONTRACTOR'S DATA

Westinghouse Electric Corp., Baltimore, Maryland.
Contract NObsr-63455, dated 29 May 1953.
Approximate Cost: $312,436.00 with equipment spares.

TUBE AND/OR CRYSTAL COMPLEMENT

(4) 5670
(8) 3B28
(1) 5R4WGB
(16) 12AT7WA
(1) 6J6WA
(1) 5651WA
(2) 6080WA
(8) 2N119
(1) H6
(2) 3DS1
(12) 6AU6WA
(2) 0A2WA
(4) 4X250B
(2) 5933WA
(2) 2N188
(2) 2N43A
(1) 2N167
(1) 3N26

Total Tubes: (70)

(35) 1N198
(4) 1N429
(2) 1N100
(8) 1N626
(1) 1N277

Total Crystals: (50)

REFERENCE DATA AND LITERATURE

NAVSHIPS 93050(A): Technical Manual for Radio Transmitting Set AN/WRT-2(XN-3) and Radio Transmitting Set AN/WRT-2(XN-4).

TYPE CLASSIFICATION
DESIGN COGNIZANCE BUSHIPS
PROCUREMENT COGNIZANCE
STOCK NO.
R.D.B. IDENT. NO.

SHIPPING DATA

NUMBER OF BOXES	CONTENTS AND IDENTIFICATION	VOLUME (Cu.Ft.)	OVERALL DIMENSIONS (Inches)	WEIGHT PACKED (lbs.)
1	Radio Transmitting Set AN/WRT-2(XN-4) Including: (1) R.F. Amplifier Unit 1 of AN/WRT-2 (XN-4) (1) R.F. Oscillator Unit 2 of AN/WRT-2(XN-4) (1) Frequency Control Group Unit 3 of AN/WRT-2(XN-4)	35.3	23-1/2 X 33 X 78-1/2	1130

RADIO TRANSMITTING SET AN/WRT-2(XN-4)

SHIPPING DATA

NUMBER OF BOXES	CONTENTS AND IDENTIFICATION	VOLUME (Cu.Ft.)	OVERALL DIMENSIONS (inches)	WEIGHT PACKED (lbs.)
	(1) Control Power Supply Unit 4 of AN/WRT-1,2(XN-1) (1) Power Supply Unit 5 of AN/WRT-1,2(XN-1)			
4	Set of Equipment Spares	4.5	15 X 20 X 26	140

EQUIPMENT SUPPLIED DATA

QUANTITY PER EQUIPT	NAME AND NOMENCLATURE	OVERALL DIMENSIONS (inches)	WEIGHT (lbs.)
1	Radio Transmitting Set AN/WRT-2(XN-4)	18 X 28 X 71-11/16	950
1	Connector AN3106A-32-8P		3/10
1	Connector AN3106A-24-28P		1/5
3	Connector UG-88/U		
2	Connector UG-573/U		1/10
1	Connector UG-572/U		1/10
1	Packing List Maintenance Prints	1 X 9 X 12	1
1	Technical Manual NAVSHIPS 95050(A)	1 X 9 X 12	1-1/2

23 April 1962 RADIO TRANSMITTING SET AN/WRT-2

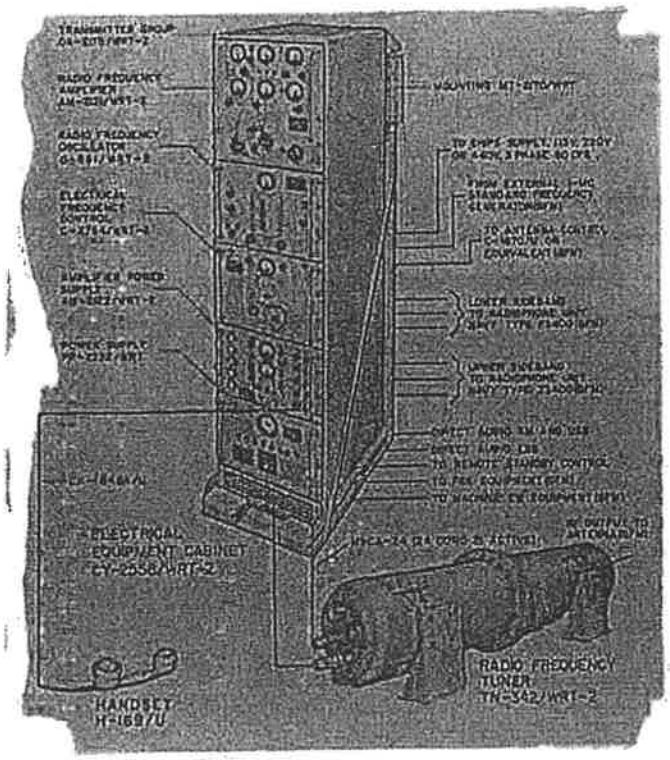
Cog Service: USN FSN: 5820-673-3770 Functional Class:

USA USN USAF

Used by

TYPE CLASS:

MANUFACTURER'S NAME/CODE NUMBER: Westinghouse Electric Corp., (89661).



Radio Transmitting Set AN/WRT-2

FUNCTIONAL DESCRIPTION:

Radio Transmitting Set AN/WRT-2 is a communication equipment designed to be installed aboard surface and undersurface vessels. The transmitter provides complete frequency coverage in one-kc steps over the frequency range of 2.0 to 30.0. The equipment is capable of delivering a nominal average power output of 500 watts and a peak envelope power (PEP) of 1000 watts into a 50-ohm, non-reactive load, with a voltage standing wave ratio (VSWR) lower than 4 to 1. The transmitter is capable of continuous full load operation under ambient temperature conditions ranging from 0 deg C to plus 50 deg C (32 deg F-122 deg F) and a relative humidity of up to 95 percent. Radio Transmitting Set AN/WRT-2 provides CW, ISB (Independent sideband), SSB (single sideband), AM phone, machine (MACH) CW, and FSK (Frequency shift keying) emission. The transmitter can be used for facsimile emission by use of the following government furnished terminal equipment: XCVR, Facsimile 1B - TT-418/TXC-1B and Radio, Modulator 1B plus T-1 MD-168/UX.

No field changes in effect at time of preparation (21 February 1961).

AN/WRT-2 RADIO TRANSMITTING SET

TECHNICAL CHARACTERISTICS:

FREQUENCY RANGE: 2.0 TO 30 mc, 1 kc steps.
FREQUENCY CONTROL: By phase-comparison circuits in conjunction with an interpolation oscillator.
TYPE OF EMISSION: CW, telegraphy, FSK, AM, SSB, ISB.
CW CHARACTERISTICS: On-off keying up to 600 wpm is provided by a transistor type keyer.
FSK CHARACTERISTICS: Is capable of accepting nutral 0 to 30 v (up to 135 v) keying signals with a voltage tolerance of porm 5%.
MODULATION CHARACTERISTICS: 100% with microphone H-51/U. May be modulated from a 600 ohm audio input circuit at a 0.006 W level.
POWER OUTPUT
ISB OPERATION: 1000 W peak envelope power (PEP, four equal tones modulation).
SSB OPERATION: 1000 W peak envelope power (PEP, two equal tones modulation, either upper or lower sideband).
CW OPERATION: 500 W average power under locked key conditions.
FSK OPERATION: 500 W average power.
AM PHONE EMISSION: 500 W average with one sideband and carrier reinsertion.
AMBIENT TEMPERATURE: 0 deg to P50 deg C (32 deg to 122 deg F); relative humidity up to 95%.
FREQUENCY STABILITY: Within one part in 10^8 per day with an ambient temperature from (4.4 deg to 32.2 deg C) P40 deg to P90 deg F and relative humidity of 40 to 90%.
POWER REQUIREMENTS: 115, 220 or 440 v, 60 cyc, 3 ph.

RELATION TO OTHER EQUIPMENT: None.

EQUIPMENT REQUIRED BUT NOT SUPPLIED:

(1) Antenna AT-660A/7; (1) Radiophone Unit MT-23400; (1) Telegraph Key MT-26012; (1) Machine Telegraphy Equipment; (1) Teletypewriter (and auxiliary equipment); (1) Antenna Tuning Group AN/BRA-3; (1) Antenna Tuning Group AN/BRA-5; (1) Handset H-51/U; (1) Antenna Control C-1670/U; (1) XCVR Facsimile TT-41B/TXC-1B; (1) Radio Modulator MD-168/UX; (as required) Bulk Cables.

MAJOR COMPONENTS

QTY	ITEM	STOCK NUMBERS	DIMENSIONS (INCHES)	WEIGHT (LBS)
1	Radio Transmitting Set AN/WRT-2 includes:			
1	Transmitter Group OA-2175/WRT-2 consists of:		21 x 29-1/2 x 72	1030
	Electrical Equipment Cabinet CY-2558/WRT-2			
	Radio Frequency Amplifier AM-2121/WRT-2			
	Radio Frequency Oscillator O-581/WRT-2			
	Electrical Frequency Control C-2764/WRT-2			

QTY	ITEM	STOCK NUMBERS	DIMENSIONS (INCHES)	WEIGHT (LBS)
	Amplifier Power Supply AM-2122/WRT-2			
	Power Supply PP-2222/WRT			
1	Radio Frequency Tuner TN-342/WRT-2		13-3/8 x 16-15/16 x 48-7/8	135
1	Handset H-169/U			
1	Connector MS/3106B-32-7P			
1	Connector MS/3106B-20-27P			
2	Connector UG-943A/U			
1	Connector 5487237H04			
1	Connector UG-635/U			
1	Connector AN3106E-32-8S			
1	Connector UG-154/U			
1	Maintenance Parts Kit		1 x 9 x 12	3
2	Technical Manual NAVSHIPS 93319(A)			
1	Mounting MT-2170/WRT			

REFERENCE DATA AND LITERATURE:

NAVSHIPS 93319(A): Technical Manual for Radio Transmitting Set AN/WRT-2.

TUBE, CRYSTAL AND/OR SEMI-CONDUCTOR DATA:

TUBES: (6) 3B28 (10) 6AU6WA (2) 5933WA (6) 5670 (8) 4CX300A (2) 6080WA (1) 5651WA (9) 12AT7WA

CRYSTALS: None used.

SEMI-CONDUCTORS: (12) 2N119 (1) 2N95 (7) 2N117 (8) 2N1122 (1) 3N34

SHIPPING DATA

PKGS	VOLUME (CU FT)	WEIGHT (LBS)
1	76	1600
1	14	195
1	1.25	
1	1.65	
1	2.3	
1	0.6	
1	0.6	

PROCUREMENT DATA

PROCURING SERVICE: USN
SPEC &/OR DWG: SHIPS-T-2958

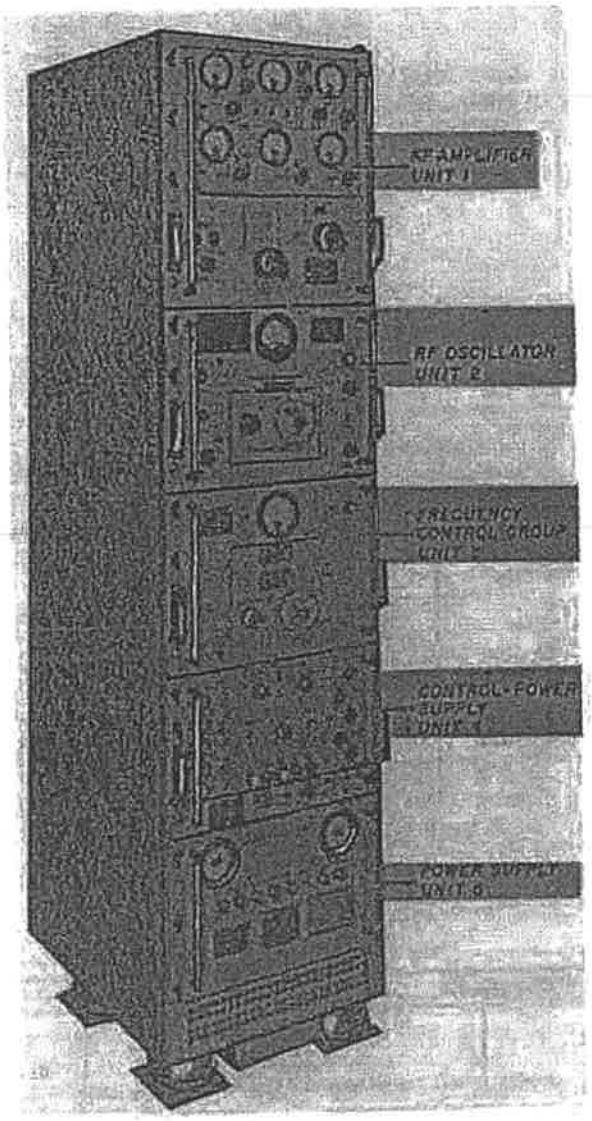
DESIGN COG: USN, BuShips

AN/WRT-2 RADIO TRANSMITTING SET

CONTRACTOR	LOCATION	CONTRACT OR ORDER NO.	APPROX. UNIT COST
Westinghouse Electric Corp.	Baltimore, Md.	NObsr-75360, 30 June 1958 NObsr-75775	

RADIO TRANSMITTING

AN/WRT-1(XN-1)



Radio Transmitting Set AN/WRT-1(XN-1),

FUNCTIONAL DESCRIPTION

The AN/WRT-1(XN-1) is a radio frequency transmitter designed for shipboard use (surface and under surface vessels). The equipment is arranged in five (5) drawer-type units. All units with exception of the bottom drawer, can be rotated, after withdrawl, about a horizontal axis to four locked positions. The transmitter is continuously tunable through the frequency range of 300 to 1500 kilocycles (kc) and is capable of supplying a nominal peak power output of at least 500 watts into a 50-ohm resistive load with a standing-wave ratio of 4:1 or better. However, the radio transmitter is limited to 100 watt operation by the power handling capacity of the antenna tuning system to which it is to be connected.

No field changes in effect at time of preparation (3 April 1959).

EQUIPMENT REQUIRED BUT NOT SUPPLIED

(1) Antenna Tuning Group Type AN/SRA-18 provides for manually (remote) matching the antenna to the R.F. output line of Radio Transmitting Set AN/WRT-1(XN-1), (1) Antenna (for R.F. Radiation), (1) Handset (carbon) type H-51/U, Optional Equipment as Required by Particular Installation, (4) Radiophone Unit Type 23500 or equivalent for remote radiotelephone control and operation Telegraph transmission. Teletype writer and Auxiliary Equipment Model 19 or equivalent for FSK operation, Machine Telegraph Equipment for C-W operation.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

TYPE OF EMISSION: Machine or break-in (hand keyed), telegraph (A1), frequency shift keyed teletype (F1) and amplitude-modulated speech (A3).
TYPE OF CONTROL: Frequency control.
FREQUENCY RANGE: 300 kc to 1500 kc.
NUMBER OF BANDS: 12 bands.
OPERATING POWER RQMT: 115 v, 220 v or 440 v, 60 cps ±5%, 2.2 kva.

MANUFACTURER'S OR CONTRACTOR'S DATA

Westinghouse Electric Corp., Baltimore, Maryland.
Contract NObsr-71092, dated 25 November 1955.
Approximate Cost: $312,436.00 with equipment spares.

TUBE AND/OR CRYSTAL COMPLEMENT

(8) 3B28	(1) 5R4WGB	(7) 6AU6WA
(12) 12AT7WA	(2) 0A2WA	(4) 4X150A
(1) 5651WA	(2) 5933WA	(2) 6080WA

Total Tubes: (39)

Radio-Transmitters

April 1960

AN/WRT-1(XN-1) RADIO TRANSMITTING

(1) 1N158 (37) 1N198 (2) 1N100
Total Crystals: (40)

TYPE CLASSIFICATION
DESIGN COGNIZANCE. BUSHIPS
PROCUREMENT COGNIZANCE
STOCK NO.
R.D.B. IDENT. NO.

REFERENCE DATA AND LITERATURE

NAVSHIPS 92893(A): Technical Manual for Radio Transmitting Set AN/WRT-1(XN-1).

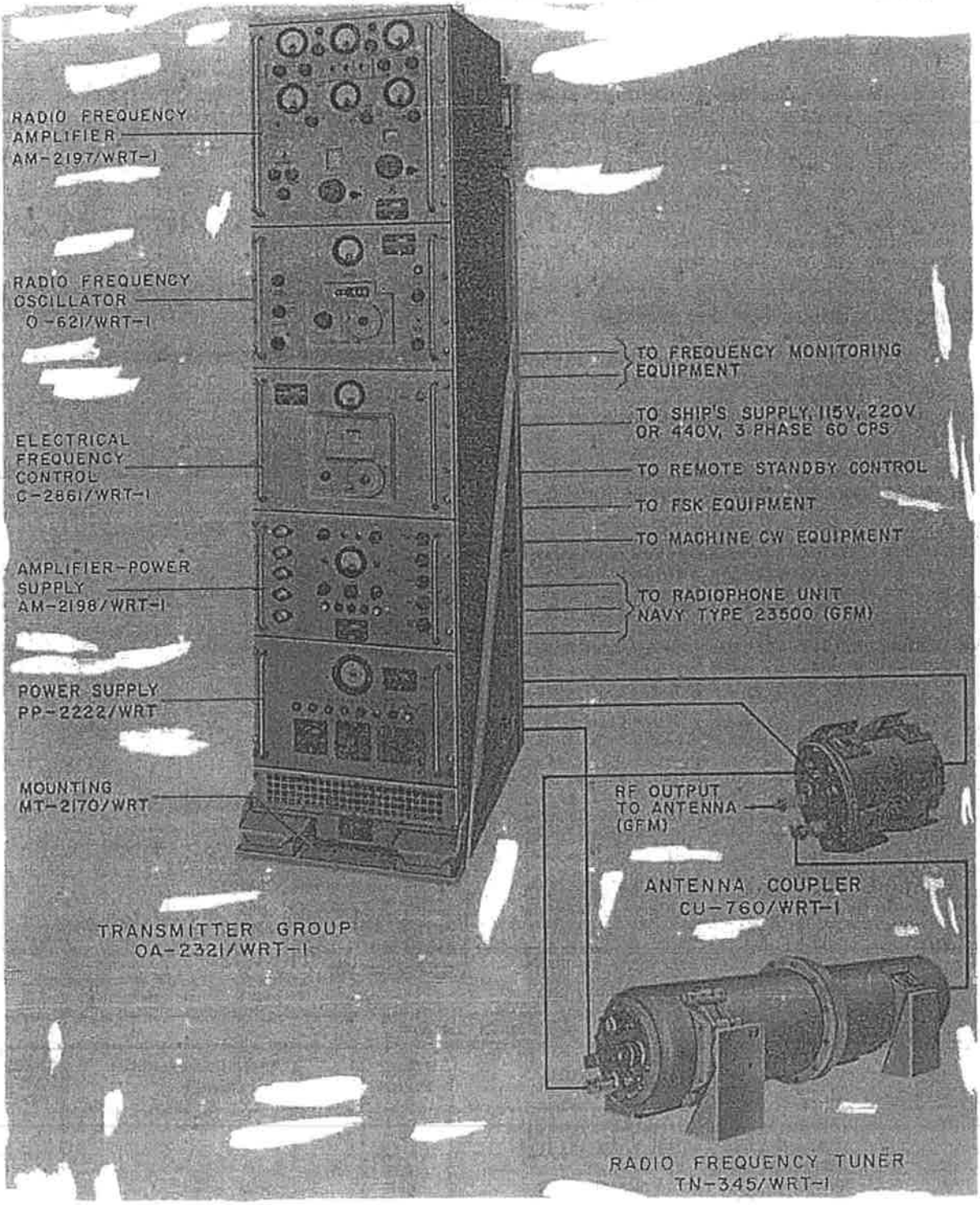
SHIPPING DATA

NUMBER OF BOXES	CONTENTS AND IDENTIFICATION	VOLUME (Cu.Ft.)	OVERALL DIMENSIONS (inches)	WEIGHT PACKED (lbs.)
1	Radio Transmitting Set Consisting of: 1-Power Supply Unit No. 5 1-Control Power Supply Unit No. 5 1-Frequency Control Group Unit No. 3 1-R.F. Oscillator Unit No. 2 1-R.F. Amplifier Unit No. 1	35.3	20 X 29 X 77	1130
1	Set of Equipment Spares	4.5	15 X 20 X 26	140
1	Set of Equipment Spares	4.5	15 X 20 X 26	140
1	Set of Equipment Spares	4.5	15 X 20 X 26	140

EQUIPMENT SUPPLIED DATA

QUANTITY PER EQUIPT	NAME AND NOMENCLATURE	OVERALL DIMENSIONS (inches)	WEIGHT (lbs.)
1	Radio Transmitting Set AN/WRT-1(XN-1)	18 X 27 X 72	950
1	Connector type AN3106A-32-8P		3/10
1	Connector type AN3106A-24-28P		1/5
1	Connector type UG-88/U		
1	Connector type UG-573/U		1/10
1	Connector type UG-573/U		1/10
1	Connector type UG-572/U		1/10
1	Packing List Maintenance Prints (1 per 2 equipments)	1 X 9 X 12	1
2	Technical Manual Navships 92893	1 X 9 X 12	3
1	Modification Kit (3 sets of line fuses for 115 v, 220 v, and 440 v operation)		
3	Maintenance Parts Kit	15 X 20 X 26	150

RADIO TRANSMITTING SET AN/WRT-1



Radio Transmitting Set AN/WRT-1

Radio-Transmitters

AN/WRT-1 RADIO TRANSMITTING SET

FUNCTIONAL DESCRIPTION

Radio Transmitting Set AN/WRT-1 is a communication equipment designed to be installed aboard surface and undersurface vessels. The transmitter is continuously tunable through the frequency range of 300 to 1500 kc and is capable of supplying a nominal peak power output of at least 500 W into a 50 ohm resistive load with a VSWR of less than 4 to 1.

No field changes in effect at time of preparation (18 November 1960).

EQUIPMENT REQUIRED BUT NOT SUPPLIED

(1) Antenna; (1) Radiophone Unit 23500; (1) Telegraph Key 26012; (1) Machine Telegraphy Equipment; (1) Teletypewriter and Auxiliary Equipment; (1) Handset (carbon) H-J1/U.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

FREQUENCY RANGE: 300 to 1500 kc.
FREQUENCY CONTROL: Accomplished by phase-comparison circuits in conjunction with an interpolation oscillator.
TYPE OF EMISSION: Machine CW, CW, frequency-shift-keyed teletype, AM speech.
CW CHARACTERISTICS: When connected to a machine cw (on-off) keyer, it is capable of operating on a dc keying voltage (negative side grounded) of 30 v porm 1.5 to 135 v porm 6.75, at the rate of 600 w.p.m., it may be hand-keyed at keying speeds up to a max of 30 w.p.m. wave-shaping circuits are provided for adjusting the rise and decay time of the output pulse for machine cw keying, teletype and multiplex operation over the range of 100 to 5000 usec.
FSK CHARACTERISTICS
NEUTRAL KEYING SIGNALS: 0 to 30 porm 1.5 v dc up to P135 porm 6.75 v dc at the rate of 60 w.p.m.
FREQUENCY SHIFT DEVIATION: Adjustable up to porm 500 cps from carrier frequency.
SWEEP RATE: 200 cps with max displacement at the transmitter output of 0 to 1 radian (approx 60 deg).
POWER OUTPUT: 500 W when connected to a 50 ohm resistive load having a VSWR of less than 4:1.
FREQUENCY STABILITY: 30 cps porm 1.5 cps per mc.
POWER REQUIREMENTS: 115, 220 or 440 v porm 10%, 60 cyc, 3 ph.
HEAT DISSIPATION
100 W OPERATION: 1.16 kw.
500 W OPERATION: 1.52 kw.

MANUFACTURER'S OR CONTRACTOR'S DATA

Westinghouse Electric Corp., Baltimore, Md.
Contract NObsr-75360.
Contract NObsr-75775.
Approximate unit cost $18,400.00.

TUBE AND/OR CRYSTAL COMPLEMENT

(7) 6AU6WA	(12) 12AT7WA
(1) 5651WA	(2) 6080WA
(6) 3B28	(2) OA2WA
(2) 5933WA	(4) 4X150A

Total Tubes: (36)
No Crystals used.
SEMI-CONDUCTORS

(1) 2N95	(3) 2N384
(8) 2N119	(1) 2N117

Total Semi-Conductors: (8)

REFERENCE DATA AND LITERATURE

NAVSHIPS 93483(A): Technical Manual for Radio Transmitting Set AN/WRT-1.

TYPE CLASSIFICATION	(NAVY)
DESIGN COGNIZANCE	USN, BUSHIPS
PROCUREMENT COGNIZANCE SPEC:	SHIPS-T-2811
STOCK NO.	
R.D.B. IDENT. NO.	

SHIPPING DATA

NUMBER OF BOXES	CONTENTS AND IDENTIFICATION	VOLUME (Cu.Ft.)	OVERALL DIMENSIONS (Inches)	WEIGHT PACKED (lbs.)
1	Transmitter Group OA-2321/WRT-1	55		1190
1	Radio Frequency Tuner TH-345/WRT-1	12.4		196
1	Antenna Coupler CU-760/WRT-1	6.5		120
1	Mounting (Part of MT-2170/WRT)	2.3	5 x 22 x 31-1/2	90
1	Mounting (Part of MT-2170/WRT)	1.1	5 x 18-1/2 x 21	52
1	Mounting (Part of MT-2170/WRT)	0.6	3-1/2 x 5-3/4 x 61	38
1	Equipment Spares	1.65	13-1/4 x 13-1/2 x 18-1/2	

RADIO TRANSMITTING SET

EQUIPMENT SUPPLIED DATA

QUANTITY PER EQUIPT	NAME AND NOMENCLATURE	OVERALL DIMENSIONS (inches)	WEIGHT (lbs.)
1	Radio Transmitting Set AN/WRT-1 includes:	21 x 29-1/2 x 72	1090
1	Transmitter Group OA-2321/WRT-1 c/o		
1	Radio Frequency Amplifier AM-2197/WRT-1		
1	Radio Frequency Oscillator O-621/WRT-1		
1	Electrical Frequency Control C-2861/WRT-1		
1	Amplifier-Power Supply AM-2198/WRT-1		
1	Power Supply PP-2222/WRT		
1	Mounting MT-2170/WRT	13-3/8 x 16-15/16 x 18-7/8	120
1	Radio Frequency Tuner TN-345/WRT-1	13-3/8 x 16-15/16 x 22-1/2	80
1	Antenna Coupler CU-760/WRT-1		
1	Connector MS-3106B-32-7P		
1	Connector MS-3106B-20-27P		
1	Connector UG-943/U		
1	Connector UG-943A/U		
1	Connector AN-3106E-32-8S		
1	Connector AN-3106E-24-28S		
1	Mounting MT-2170/WRT		
1	Maintenance Parts Kit	1 x 9 x 12	0.07
2	Technical Manual NAVSHIPS 93483(A)		

TED-3 RADIO TRANSMITTING EQUIPMENT

March 1957

FUNCTIONAL DESCRIPTION

The TED-3 is a short range communications equipment suitable for use in ships, submarines or shore stations, its range is generally "line-of-sight" distances. The equipment is suitable for mounting in a standard 19 inch relay rack or installed in a cabinet supplied for its housing.

No field changes in effect at time of preparation (31 August 1956).

RELATION TO OTHER EQUIPMENT

Equipment Required but not Supplied:
Remote Radio-Phone Unit NT-23500, Hand Telephone Assy NT-51081 or Chestset NT-51090, Loudspeaker Unit NT-49546, Amplifier Unit NT-50210, Antenna NT-66147, AT-150/SRC, AS-390/SRC, Interconnecting Cables, Crystal Unit NT-CR-24/U.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

FREQUENCY RANGE: 225 to 400 mc.
FREQUENCY CONTROL: Crystal.
TYPE OF EMISSION: A2, A3.
CARRIER OUTPUT: 12 to 15 W.
IMPEDANCE
INPUT: 600 ohms (for microphones).
OUTPUT: 50 ohms (to antenna).
POWER SOURCE REQUIRED: 115 or 230 v AC, 50 to 60 cps, single phase.

MANUFACTURER'S OR CONTRACTOR'S DATA

Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.
Contract: NObsr-52310 dated 15 March 1951.
Contract: NObsr-64599.
Approximate Cost $2040.00 with equipment spares.

TUBE AND/OR CRYSTAL COMPLEMENT

(2) 3B28
(2) 5726/6AL5W
(1) 5749/63A6W
(3) 12AT7WA
(3) 4X150A
(1) 6AT6
(2) 807
(4) 5B14/12AU7
Total Tubes: (18)
(1) 1N21B
Total Crystals: (1)

REFERENCE DATA AND LITERATURE

NAVSHIPS 91796 (A) Technical Manual for Radio Transmitting Equipment for Model TED-3.

TYPE CLASSIFICATION
DESIGN COGNIZANCE BUSHIPS
PROCUREMENT COGNIZANCE
STOCK NO.

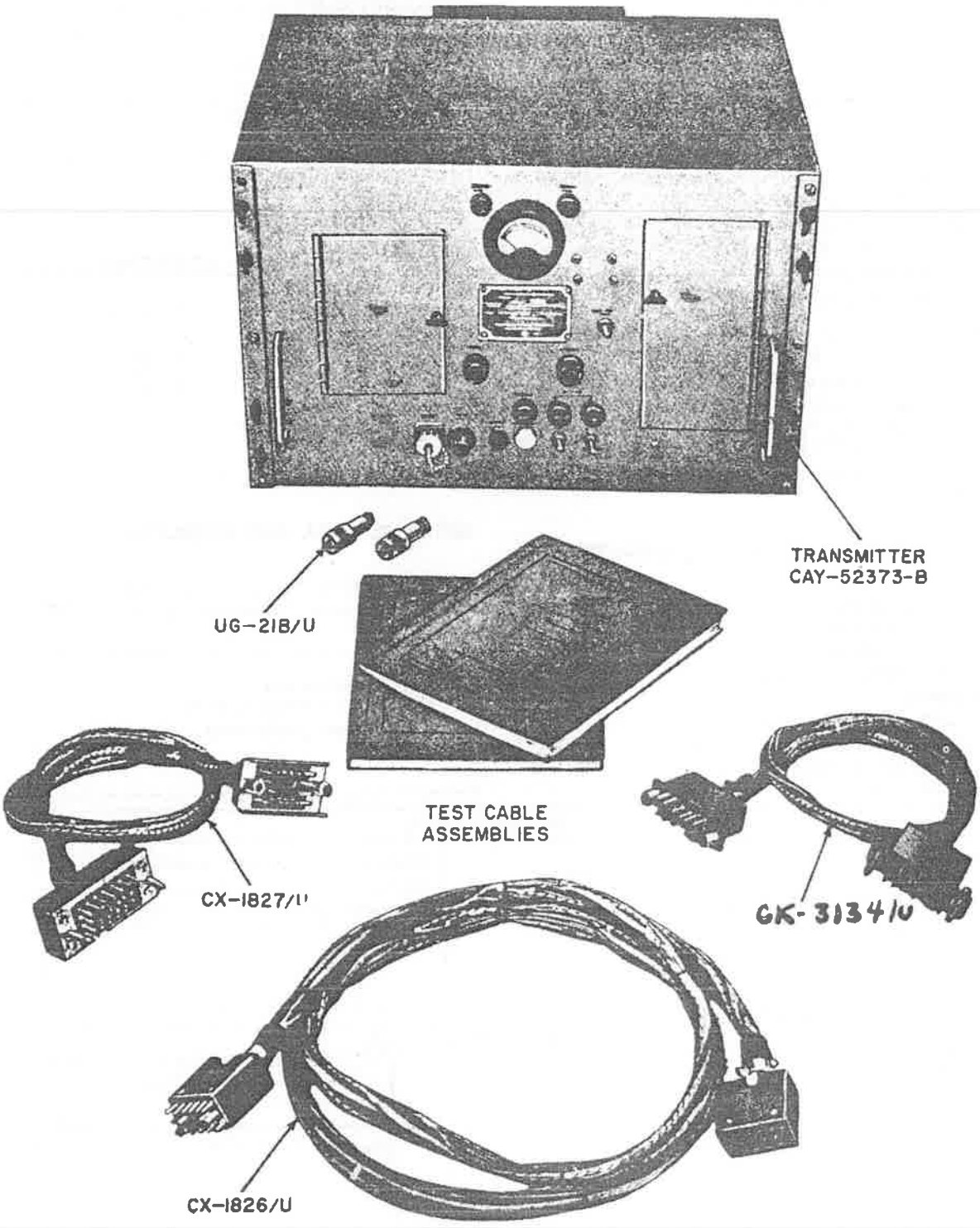
SHIPPING DATA

NUMBER OF BOXES	CONTENTS AND IDENTIFICATION	VOLUME (Cu.Ft.)	OVERALL DIMENSIONS (inches)	WEIGHT PACKED (lbs.)
1	Radio Transmitter NT-52373/B including:	9.4	22-1/2 X 25-3/4 X 28-1/2	212
	Cable Assy NT-1826/U			
	Cable Assy NT-1827/U			
	Cable Assy NT-3134/U			
1	Set Equipment Spares	5.3	16 X 20 X 29	119

EQUIPMENT SUPPLIED DATA

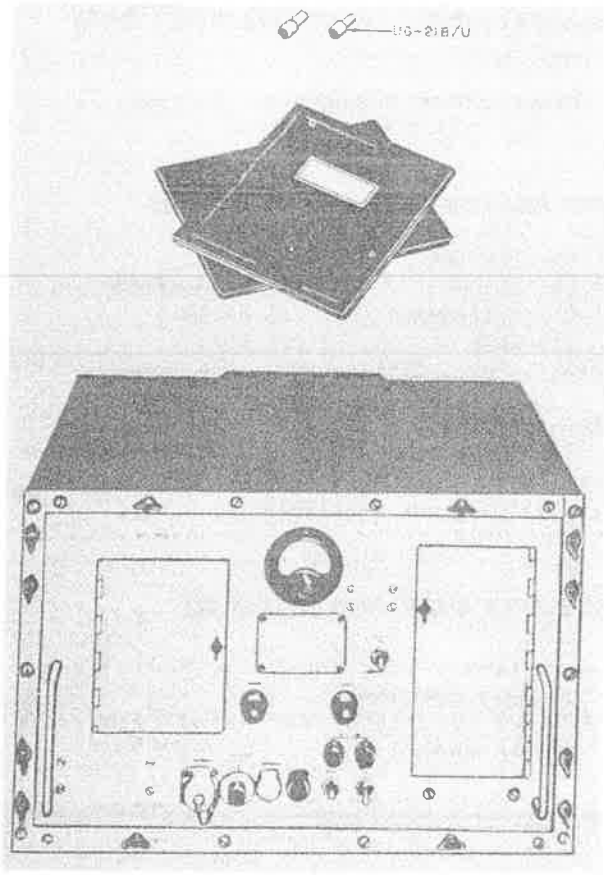
QUANTITY PER EQUIPT	NAME AND NOMENCLATURE	OVERALL DIMENSIONS (inches)	WEIGHT (lbs.)
1	Radio Transmitter NT-52373-B	13-23/32 X 15 X 19	144
1	Cable Assy NT-1826/U		
1	Cable Assy NT-1827/U		
1	Cable Assy NT-3134/U		
2	Plug NT-215B/U		
2	Technical Manuals NAVSHIPS 91796(A)		
1	Set Equipment Spares	12-1/8 X 16-1/2 X 25-1/4	89

RADIO TRANSMITTING EQUIPMENT



Radio Transmitting Equipment TED-3

RADIO TRANSMITTER TED-7



Radio Transmitting Equipment, Navy Model TED-7

FUNCTIONAL DESCRIPTION

The Navy Model TED-7 is designed as a short-range communication equipment that can be used in ships or in shore installations. Its effective range is normally limited to "line-of-sight" distances since it operates in the frequency band of 225 to 400 megacycles (mc) per second. A2 or A3 transmission can be used. When voice transmission is used, special circuits in the transmitter modulator section provide higher speech intelligibility for a given carrier level than is obtained with conventional circuits. Standard Navy Shipboard remote control units can be used to operate the transmitter.

Data on this sheet reflects the following field changes: Field Change No. 1 dated 23 January 1957.

EQUIPMENT REQUIRED BUT NOT SUPPLIED

(4) Remote Radio-phone Unit Navy Type No. 23500, (1) Hand Telephone Ass'y Navy Type No. 51081, or (1) Chestset Navy Type No. 51090, (1) Antenna Navy Type No. 66147 or AT-150/SRC or AS-390/SRC, (1) Crystal Unit CR-24/U.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

TYPE OF FREQUENCY CONTROL: Crystal
TYPES OF EMISSION AND MODULATION CAPABILITY: A2 (MCW) 90%; A3 (phone) 100%.
NOMINAL CARRIER OUTPUT: 12 to 15 w.
FREQUENCY STABILITY: Plus or minus 0.007% under any conditions or combination of conditions.
IMPEDANCE
INPUT: 600 ohms.
OUTPUT: (to antenna) 50 ohms.
AUDIO INPUT VOLTAGE: Minus 25 db to plus 5 db from a 0.006 watt reference level (0.1 to 3.4 volts).
AUDIO FREQUENCY RESPONSE CHARACTERISTICS: Flat within plus or minus 3 db from a 1000 cps response level, from 300 to 3,500 cps.
HEAT DISSIPATION: 725 w.
POWER SUPPLY DATA
MAXIMUM LINE VOLTAGE VARIATION: ±10%.
INPUT POWER: 750 w.
POWER FACTOR: 0.85.
OPERATING POWER REQUIREMENT: 115 to 230 v AC, 50 to 60 cps, single ph.

MANUFACTURER'S OR CONTRACTOR'S DATA

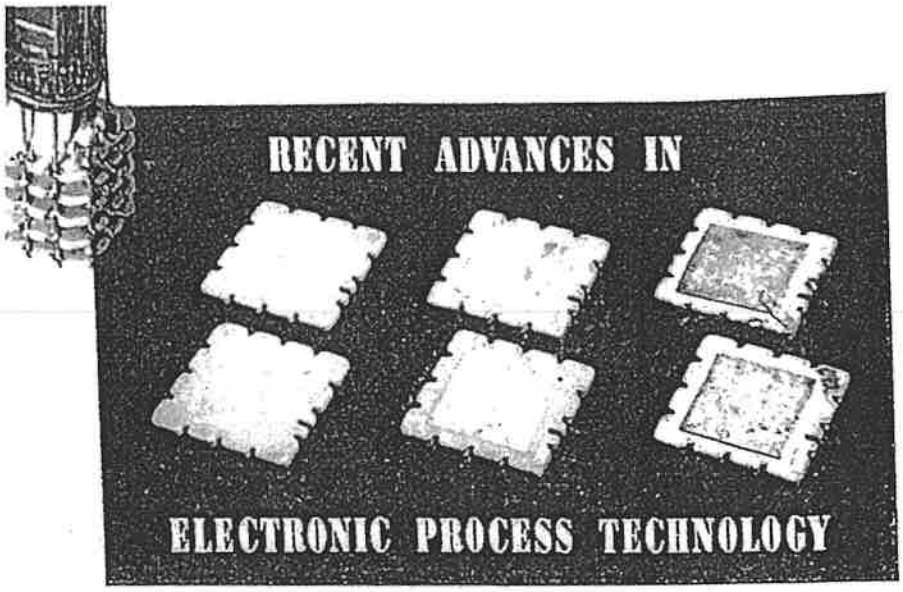
CBS Columbia, Long Island City, N.Y.
Contract NObsr-59925, dated 10 December 1954.
Contract NObsr-64800, dated 24 June 1955.
Approximate Cost: $87,691.10 with equipment spares.

TUBE AND/OR CRYSTAL COMPLEMENT

(2) 3B28	(3) 4X150A
(1) 6AT6	(3) 12AT7WA
(2) 807	(2) 5726/6AL5W
(1) 5749/6BA6W	(4) 5814/12AU7

Total Tubes: (18)

EXHIBIT E



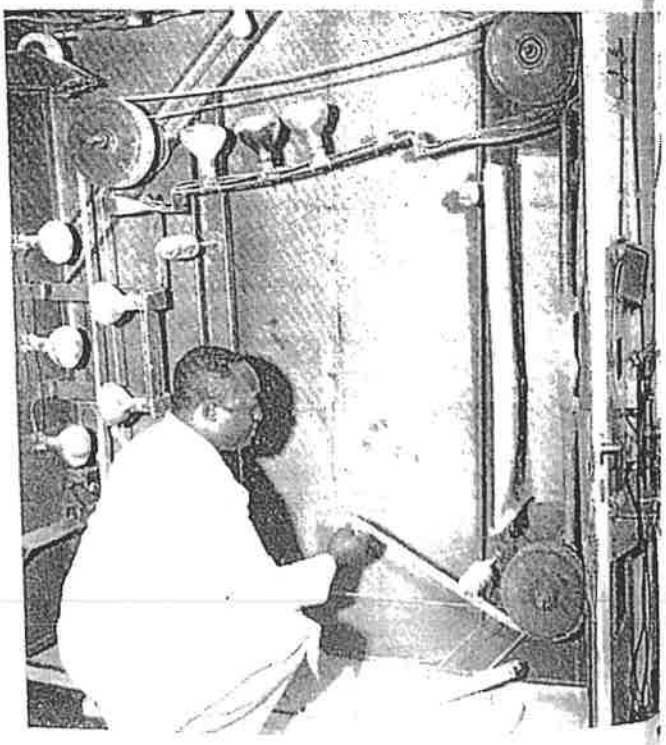
MDE–MPE tape capacitors in stages of production. Wafers at left are cured steatite blanks of same general type used in MDE–MPE system. Silver pattern that forms one electrode of capacitor has been applied to two wafers in the center. In wafers at right, adhesive dielectric-coated tape is cut into squares slightly larger than the silver contact and then pressed down onto the wafers. After curing, the capacitor is ready to be assembled into a module with other wafers such as that shown at top left.

SINCE the announcement of a new system for the mechanized production of electronics in 1953, the National Bureau of Standards has developed additional compatible components and techniques under the sponsorship of the Navy Bureau of Aeronautics. Recent advances achieved by NBS in electronic process technology include an adhesive tape capacitor, a "chip" resistor, and a method for applying pyrolytic carbon resistors. Developed by B. L. Davis of the Bureau's process technology laboratory, these components and techniques should do much to increase the versatility and applicability of electronic equipment manufactured by automatic production lines.

The development of systems for Modular Design of Electronics and Mechanized Production of Electronics (MDE–MPE), formerly code-named Project Tinkertoy, was begun by the Bureau with the cooperation of several industrial companies under the sponsorship of the Navy Bureau of Aeronautics as an industrial preparedness measure. The MDE–MPE system starts with raw or semiprocessed materials and automatically manufactures ceramic base wafers, dielectric elements for capacitors and adhesive tape resistors; prints conducting circuits and capacitors; and mounts resistors, capacitors and other component parts on standard, uniform steatite wafers. The wafers are stacked like building blocks to form modules that perform all the functions of one or more electronic stages. The pilot plant, operated by a commercial contractor, incorporates the principles of this system. The plant was designed to produce 1,000 finished and inspected modules per hour.

The Tape Capacitor

The self-adhesive tape capacitor is designed specifically for application to the ceramic wafer by MDE–MPE machine techniques. It is manufactured in much the same manner as the NBS adhesive-tape resistor.[1] A conducting tape, coated on one side with a dielectric, provides one element of the capacitor. The other element is a silver pattern printed and fired on the wafer. It is now possible to apply an adhesive-tape



In this chamber electrically conducting solution is sprayed on one side of tape, dried, and then sprayed on other side. When cured, dielectric formulation is sprayed on one side of tape. It is then ready to be used as one element of the capacitor. Spray unit can be seen at far right.

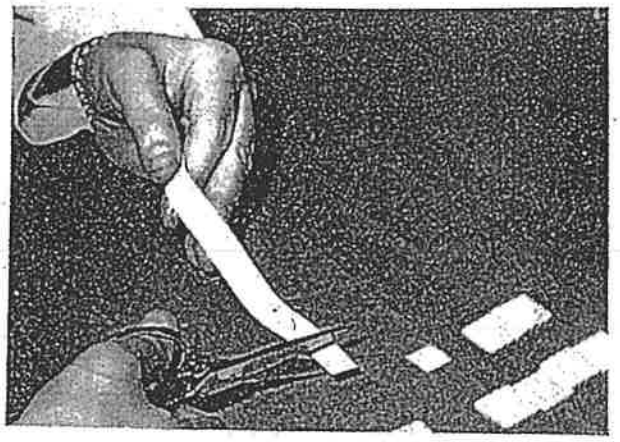
Application of adhesive tape capacitor to wafer. Although shown here as a manual operation for demonstration purposes, it is normally applied by machine.

resistor to one side of a wafer and an adhesive-tape capacitor to the other side.

The materials required for the manufacture of tape capacitors are a heat-resisting asbestos paper tape, silver flake, silicone resin, butyl cellosolve, a powdered high-K titanate body, *n*-hexane, and epoxide resin. The electrically-conducting formulation (a mixture of the silver flake, silicone resin, and solvent) is ground in a ball mill. The mixture is sprayed on a loop of tape 1¼ in. wide, allowed to dry thoroughly, and then sprayed on the other side. When cured, the metallized tape is conductive along each side and from one side to the other. After slitting along the center to form two ⅝-in tapes, it is ready for application to the dielectric film. A roll of tape 19 ft long will produce about 350 capacitors.

The dielectric formulation is composed of high-K titanate body that has been pulverized in a ball mill with *n*-hexane until the particle size is about 1 to 2 microns, after which the slurry is allowed to evaporate under a hood. The ground titanate body is mixed with epoxide resin and further ball-milled. This tacky dielectric mixture is then sprayed on the metallized base tape in various thicknesses determined by the number of passes the tape makes in front of the spray gun. Thicker applications, of course, make capacitors of lower value.

The silver pattern that forms one electrode of the capacitor is applied to the steatite wafer by means of a screen press. It is then dried and fired onto the ceramic. The adhesive dielectric-coated tape that forms the other electrode is cut into squares slightly larger than the silver contact and pressed down on it. A narrow conductive strip, similar to resistor tape but with a conductivity of approximately 0.02 ohm per half inch, is laid down between a contact on the edge of the wafer and the top side of the capacitor. The



complete assembly is then cured by placing it in a oven at room temperature, raising it to 225° C over period of one-half hour, and holding the temperatur at 225° C for 45 minutes.

Capacitors of higher values can be manufacture by applying a number of layers of tape, one on to of another, with appropriate connections to the edg of the wafer. Smaller capacitors can be made by reducing the area of the silver pattern printed on the wafer, or by increasing the thickness of the dielectric layer. For typical values, see table 1.

Second element of capacitor is a silver pattern printed on an MDE-MPE wafer. Elements may be printed on either or both sides, depending on requirements of finished circuit. An adhesive tape resistor can be applied to opposite side of wafer instead of a capacitor, if desired.

Shelf life tests indicate that the capacitance changes no more than 1 percent during the first month after manufacture, and that there is no change in the dissipation factor, which averages 0.7 percent at 1 kc. However, the capacitance does change somewhat with temperature, −3 percent from 25° to 85° C, and −15 percent from 25° to −55° C. In a load life test, a few capacitors shorted out, but otherwise only negligible changes occurred in capacitance and dissipation factor.

The "Chip" Resistor

The "chip" resistor is made by applying self-adhesive resistor tape to a small chip of ceramic material. This resistor is not for use in the regular quantity production of modules, but aids the electronic design engineer in studying new modular circuits which are still in the "breadboard" stage or in producing prototype equipments for evaluation. The chip is inserted into a circuit simply by soldering it to the appropriate connections on a standard wafer.

The precured resistor tape is manufactured automatically by the usual MDE–MPE techniques but is applied to a chip of cured steatite about 0.600 by 0.225 in. instead of the standard MDE–MPE wafer. A prototype machine developed in the NBS laboratories

of a highly accurate gas thermometer for this purpose requires painstaking and time-consuming precision, the work on the secondary thermometer is being pursued concurrently. Resistance thermometers constructed of the semiconducting elements, silicon and germanium, have proved to be extremely sensitive; in some cases the resistance changes more than 50 percent per degree. While satisfactory reproducibility still remains a problem, results of initial tests have been quite promising.

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[6] J. B. Garrison and A. W. Lawson, Absolute noise thermometer for high temperatures and high pressures, Rev. Sci. Inst. **20**, 785 (1949).

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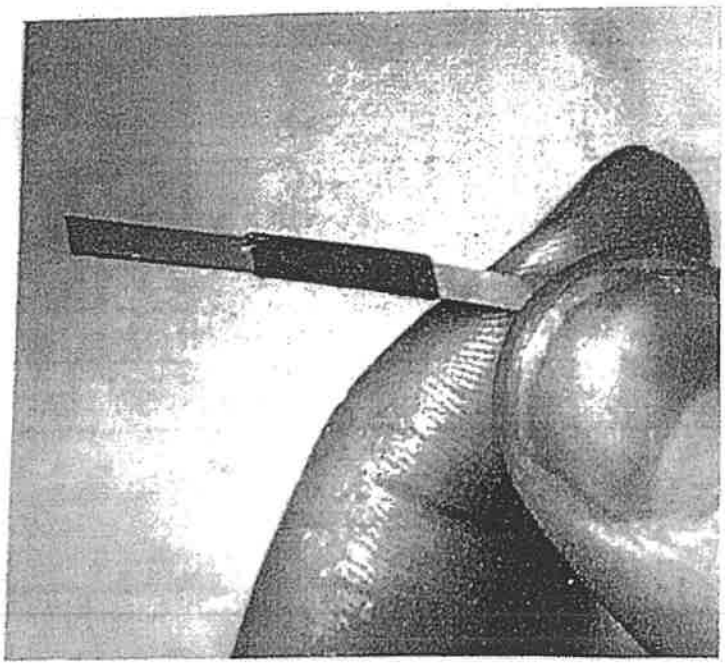
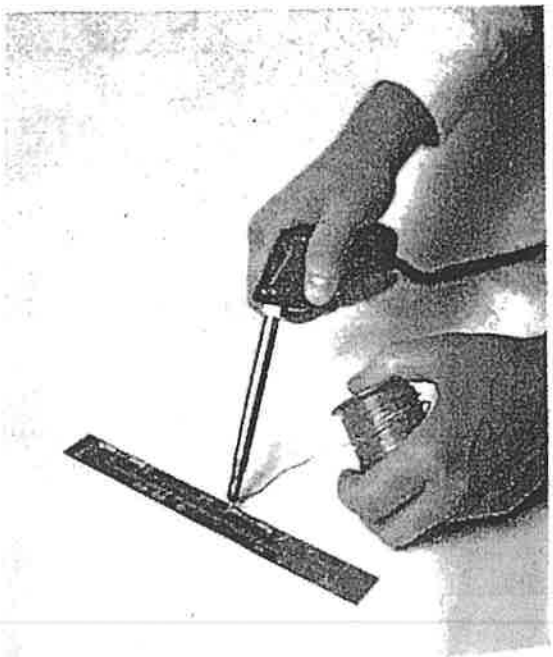
NBS Precured Tape Resistor

THE ADHESIVE-TAPE resistor developed by the Bureau has aroused wide interest since its announcement in 1951.[1] In the NBS tape-resistor system, designed primarily for electronic printed-circuit applications, small pieces of self-adhesive resistance-coated tape are simply pressed into place against metallic terminals at the proper points in the circuit. The resistor was developed as part of a program of miniaturization of airborne equipment sponsored by the Navy Bureau of Aeronautics. Despite its advantages, the method has been limited in some applications by the necessity for baking the supporting base material to cure the resistors after they have been pressed in place.

A new precured wire-lead version of the tape resistor, now being made at NBS, obviates the need for heat-curing after placement in the circuit. The new resistors are made by pressing uncured resistor tape against both sides of suitable wire or metal-ribbon leads; the leads are thus sandwiched between two pieces of resistor tape. These units are then given the usual heat cure, which bonds the resistor tape to the

[1] A high-temperature adhesive tape resistor, *NBS Tech. News Bull.* **35**, *100 (July 1951). Described in detail in* An adhesive tape resistor system, *NBS Circular 530, Government Printing Office, 30¢.*





Left: the recently developed precured version of the Bureau's tape resistor can be soldered or spot-welded into the circuit. The original version of the NBS tape resistor is self-adhesive, but must be heat-cured by baking the chassis after all resistors have been pressed in place. The precured resistor is made by sandwiching suitable metal leads between two uncured resistors and then heat-curing, which bonds the resistor to the leads. Over-all length is about 1½ inches. *Right:* soldering one of the precured NBS tape resistors into place. Because no subsequent heat-curing is needed, this version of the tape resistor can be used with chassis that would not withstand curing temperatures (about 300° C.).

leads and results in resistors that may be soldered or spot-welded into the circuit.

With the new precured variation in addition to the basic press-on form, the range of possible applications of the NBS tape resistor is greatly extended. Characteristic advantages of the NBS tape resistor—compactness, stability, and high-temperature operation—are largely retained in the precured wire-lead design. Furthermore, the new resistor might well prove more economical to manufacture in quantity than other types having less desirable characteristics.

The basic NBS tape resistor is made by coating asbestos-paper tape with a mixture of carbon black or graphite, silicone resin, and solvent. Resistor dimensions are standardized at one-half inch long and about one-eighth inch wide; a variety of coating formulations have been developed to give a wide range of resistor values.

Leads for the precured tape resistor are now being made from ribbon of thin silver or silver-plated copper at NBS. Leads extending one-half inch beyond the resistor proper are used, bringing the over-all length to 1½ inches. Thickness is held to about 0.012 to 0.015 inch.

Preliminary tests indicate that the precured NBS tape resistor, when supported in air by its leads alone, will not provide the full dissipation of 0.25 watt at 200° C for which the basic resistor was designed. Further test work is now in progress, and a suitable derating curve will be worked out.

New NBS Director Appointed

DR. ALLEN V. ASTIN has been appointed* Director of the National Bureau of Standards. Formerly Associate Director of the Bureau, Dr. Astin has been Acting Director since October 1951. Dr. Astin has also been appointed a member of the National Advisory Committee for Aeronautics.

Dr. Astin has been a member of the Bureau's staff since 1932. Until 1940 he was principally concerned with dielectrics and electronics. His contributions include development of improved methods for precise measurement of dielectric constants and power factors of dielectric materials and studies of the nature of energy losses in air capacitors. He did pioneering work in the development of radio telemetering techniques and instruments and applied this work to studies of cosmic rays and of meteorological problems in the earth's upper atmosphere.

In 1940 Dr. Astin was one of the Bureau scientists doing pioneering work in proximity fuze research and development for bombs and rockets. He became chief of the Optical Fuze Section in 1943, assistant chief of the Ordnance Development Division in November 1943, and chief of the Division in July 1948. He played a major part in the development and evaluation of bar-type proximity bomb fuzes and in their introduction to service during the war. During the fall and winter of 1944–45 he served in Europe as representative of the Bureau and consultant for the Ordnance Accessories Division of the National Defense Research Committee, concentrating on proximity fuze problems. He edited the terminal three-volume Technical Report of the Ordnance Accessories Division (Division 4).

As chief of the Ordnance Division from 1948 to 1950, he supervised the Ordnance Laboratory, the Guided Missile Laboratories, and the Electronics and Tube Laboratories. When Dr. Astin was appointed Associate Director in May 1950, he assumed responsibility for the work of the Ordnance Development, Missile Development, Electricity, and Electronics Divisions as well as the Office of Basic Instrumentation.

Dr. Astin was born in Salt Lake City, Utah, on June 12, 1904. He received the B. S. degree in physics from the University of Utah in 1925. While working toward his advanced degrees at New York University from 1925 to 1928, he was a graduate assistant and instructor in physics. From N. Y. U. he obtained the M. S. and Ph.D. degrees in physics in 1926 and 1928 respectively. From 1928 to 1930 he held a National Research Council Fellowship at Johns Hopkins University, doing basic research on measurement techniques relating to dielectric materials. Between 1930 and 1932, he was a Research Associate in a program sponsored at the Bureau by the National Research Council and the Utilities Research Commission, Inc.

Honors and awards he has received include the following: National Research Council Fellow in Physics, 1928–1930; Navy Ordnance Award for Exceptional

Dr. Allen V. Astin

Patented Aug. 6, 1935

2,010,133

UNITED STATES PATENT OFFICE

2,010,133

RESISTOR

Sidney Bloomenthal, Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

No Drawing. Application November 25, 1933, Serial No. 699,767

16 Claims. (Cl. 201—76)

My invention relates to resistors and more particularly to resistors of types suitable for use in radio receivers, wherein noise occasioned by variations in resistance during the passage of current therethrough must be minimum.

Resistors of types used in radio receivers must be "quiet". That is to say, since such resistors are usually utilized in connection with sensitive thermionic devices, their resistance must not fluctuate while they are conducting electric currents. This requirement must be met to a greater or less degree in the manufacture of all resistors of the types under discussion.

A resistor for use in radio receivers should also have a substantially zero temperature coefficient of resistance and a low load-coefficient of resistivity. That is to say, it should be so made that temperature changes occasioned either by atmospheric conditions or by the passage of electric current therethrough will not materially affect the resistance value.

It is, accordingly, an object of my invention to provide a new and improved resistor that shall be substantially free from noise when used in an amplifier.

Another object of my invention is to provide a resistor that shall have a substantially zero temperature coefficient of resistance during normal operation thereof.

Another object of my invention is to provide a resistor that shall have a low load-coefficient of resistivity.

It is also highly desirable that manufacturing methods be devised and materials provided whereby quantity production of resistors having accurately predetermined values may be had. It is, accordingly, a further object of my invention to provide such methods and such material.

A still further object of my invention is to provide a new resistor material capable of being molded into any desired shape with full assurance that the resulting device will have the predetermined resistance and temperature coefficient characteristics.

The foregoing objects and other objects ancillary thereto I prefer to accomplish, in short, by first coating particles of a filler material, such as asbestos, powdered glass, sand, or the like, or a mixture of filler materials, with a polymerizable resin in solution and thereafter causing conducting material, preferably graphite and/or carbon black, to be precipitated upon the coated particles from a colloidal solution thereof.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment.

Substantially all fixed resistors used in radio receivers, amplifiers, and the like, include a filler, a conducting material, a binder, and a moisture-repellent impregnating material. The electrical and mechanical properties of the resistor depend not only upon the nature of these components but on the manner in which they are put together.

Previous to my present invention, I made many experiments in the effort to utilize asbestos, glass, or sand singly as well as various mixtures of sand or glass and asbestos, as fillers. For a binding material, I tried many grades of phenol formaldehyde resin in liquid and powdered form or in the form of varnish. For the conducting material, I tried dry graphite and carbon black, but in all of my early experiments I found that, if the conducting material was first mixed with the filler and the binder thereafter added, the resistors made from such a compound were extremely variable in resistance value and could not accurately be reproduced by factory processes.

According to my invention, therefore, I first take a predetermined amount of finely ground glass and air floated asbestos and intimately mix with it a solution of phenol formaldehyde resin (known as bakelite) in acetone. The principal function of the ground glass is to impart to the finished resistor a rough surface to which paint and sprayed metallic terminals will firmly adhere. For the mixing process, I prefer to use a device commercially known as a "kneader" and continue the kneading process until substantially all of the solution is evaporated. At this stage in the process, the mass of material has a dough-like consistency and if a small portion of it is examined under a microscope, it will be apparent that every particle of the asbestos and glass is covered with a film of unpolymerized resin left by the evaporation of the acetone.

The "mix" is next removed from the kneader and is crumbled into particles which are allowed to stand until all of the solution evaporates and it becomes quite hard and brittle. The material is next placed in a ball mill, or grinder of any convenient type, and is ground until substantially all of it becomes fine enough to pass an 80 mesh screen.

While the process of grinding is being carried

on, the conducting material may well be in course of preparation. For this material, I prefer to use a colloidal suspension of carbon in water, such as the graphitic material known to the trade as "Aquadag", manufactured by the Acheson Graphite Company, a gas-carbon suspension known as "Aquablack", manufactured by Binney & Smith Company, or a suitable mixture of the two.

In view of the fact that graphite has approximately one-tenth the resistance of carbon, such as is utilized in the manufacture of aquablack, these two commercial materials cannot be interchangeably utilized in the same proportions. It is, however, desirable to use aquadag for resistor elements having relatively low resistance and aquablack or mixtures of the two suspensions, suitably diluted, for resistors having relatively high resistance.

For resistors having high resistance values, it is particularly desirable to use mixtures of graphite and carbon black made from natural gas. If graphite alone is used for such resistors, the proportion thereof is so small that the particles are quite widely separated. This condition gives rise to noise which is obviated by the presence of carbon black particles that effectively "bridge" the graphite particles.

The 80-mesh resin coated particles are next intimately mixed with the colloidal carbon suspension, which has been diluted with water to a point whereat the liquid is substantially 1% carbon by weight, by a stirring operation and, for this purpose, mixing apparatus of substantially any well known commercial type may be utilized.

For the purpose of explanation of the foregoing paragraph, it is to be understood that the term "colloidal carbon suspension" is intended to include diluted aquadag, diluted aquablack, or a diluted mixture of the two. It is also within the scope of my invention to first mix the resin coated particles with either one or the other of the first-mentioned solutions, and to thereafter mix or add the other solution, thus causing successive precipitation of carbon in different forms on the particles.

Under usual conditions of manufacture, the introduction of the resin-coated filler material into the colloidal carbon suspension disturbs the electric charge relations existing in the said suspension, with the result that the carbon is precipitated onto the filler material and forms a conductive film over the entire surface of each minute particle thereof. Under certain conditions the colloidal suspension of the carbon persists and, in such case, I find it advisable to add to the mixture a small amount of hydrochloric acid which coagulates it and causes the precipitation hereinbefore mentioned. As an alternative, for the purpose of coagulating the colloidal suspension, I may add to the acetone solution of the resin, before coating the filler particles therewith, a small amount of furfural or of some other volatile material such as acetic acid, having an ionizable hydrogen atom with which it readily parts. For this purpose, I have also obtained fairly good results with small quantities of an organic acid such as malic, citric, tartaric, or the like.

After the carbon is precipitated onto the filler material particles, the supernatant liquid is either drained off or the solution is filtered in a filter press or the like. The cake resulting from the filtering process is dried at a temperature of approximately 40° C., for 24 hours, or, at least, for a period of time sufficient to drive off substantially all of the residual moisture.

In order that the continuity of the carbon film on the filler particles shall not be interrupted, the dried cake must be handled rather carefully. In other words, it is highly inadvisable to subject the cake to any further grinding operations to prepare it for handling, and at this point in the process it is found best to manually crumble the cake into small particles suitable for charging a molding machine.

The crumbled material is next loaded into the hopper of an automatic "pill" making machine, such as is used in the drug industry, or into equivalent well-known apparatus, which forms it into cylindrical rods under a pressure of the order of ten tons per square inch. For the sake of uniformity, I prefer to form rods ¾" in length and ¼" in diameter if the power rating thereof is not to be in excess of one watt. The rods made as described are then placed in trays and baked in an oven at 170° C. for approximately one hour.

I am not, at this time, prepared to exactly explain all of the physical changes caused in the pill by the baking process and consequent polymerization of the resin coating underlying the carbon on each particle of filler.

It appears, however, that during the baking step of the process, the carbon films on the particles merge together to provide what might be termed a "honeycomb" structure, of conducting material, and that the polymerization of the binder serves to lock the elements of the said honeycomb structure firmly in place, without disturbing the continuity of the carbon contacts. However, in view of the fact that the carbon films are extremely thin, it is, of course, probable that some of the resin may seep through them and bond with resin from other particles. As a matter of fact, the binder does not appear to have any pronounced insulating action and it may well happen that the theory first above given is correct.

In order that my disclosure shall be complete, the following specific directions for making 1000 resistors, each having a resistance of 700 ohms and each capable of dissipating one watt, are given:

For the above purpose, I take 5 lbs. of glass ground to pass a 150 mesh screen, 2¼ lbs. of air-floated asbestos, and mix them in a kneader with 1.62 lbs. of phenol-formaldehyde resin dissolved in 8 lbs. of acetone.

To coat the amount of filler material specified, in order to obtain the desired resistance characteristic, requires .126 lbs. of graphite. This weight of graphite is contained in .63 lbs. of commercial aquadag which is diluted by adding to it approximately 5½ pints of distilled water to form a colloidal suspension having the required density.

The following table gives relative proportions of filler, resin, and carbon for a number of finished resistors ¾" long and ¼" in diameter:

Asbestos	Resin	Graphite	Carbon black	Glass	Resistance
Percent	*Percent*	*Percent*	*Percent*	*Percent*	
72	25	3	----------	----------	700 ohms.
73	25	2	----------	----------	2000 ohms.
74	24.5	1.5	----------	----------	500000 ohms.
24	18	.7	2.3	55	1.2 megohm.
24	18	1.2	2.3	54	17000 ohms.
24	18	1.4	2.3	54	11000 ohms.

From the foregoing table, it will be apparent

that a resistor having any desired resistance characteristics may be made by suitably choosing the relative amounts of filler and conducting material. It will also be noted from the table that the variation in the resin content plays a very minor part in the resistance of the finished article, which is in accordance with the theory hereinbefore advanced.

After baking, the resistor rods must, of course, be provided with suitable terminals. For this purpose, I find it best to utilize the Schoop metal spraying process and I apply to each end of the resistor a ring of copper or tin extending inwardly from the end a distance of $\frac{1}{16}$". Obviously, the resistance of the rod measured from end to end can be further controlled at this point in the process by adjusting the width of the sprayed terminals. As a general rule, however, this is not done in the factory, for the reason that it is much more convenient to so arrange the spraying machinery that all resistors are provided with terminals of the same width.

After the terminals have been sprayed onto the ends of the rods, the rods are immersed in a moisture-repellent impregnating material such as melted carnauba wax, aerclor, halowax, sincera wax, cerawax, paraffin, linseed oil, or the like, which has no solvent action on the polymerized resin at any operating temperature. The melted wax is preferably maintained at a temperature of 170° C., and the rods are kept therein for approximately forty five minutes. Carnauba wax is particularly advantageous to use as the impregnating material since, by reason of its expansion within the interstices of the resistor rod, at temperatures below its melting point, it compensates, to some extent, for changes in resistance occasioned by temperature rise. I have also found linseed oil to be quite satisfactory, since it oxidizes and forms a surface coating which is thoroughly waterproof. Linseed oil, however, necessitates an extra baking step to effect this oxidation.

A resistor manufactured according to my improved method offers many advantages not heretofore obtained. In the first place, the process utilizes carbon which can be purchased in its processed form and is immediately available. Secondly, the resistance values can be duplicated fairly accurately and, in addition, the electrical characteristics can be accurately determined and controlled, while the finished resistors exhibit extremely low load coefficients of resistivity. Naturally, I am aware that certain of the mentioned advantages have been approached in the past, but it is my belief that no resistor now on the market exhibits them to as great an extent as a resistor manufactured according to my improved process.

Although I have disclosed herein certain specific proportions of filler, resin, and conducting material, these are given merely by way of example and are not to be construed as in any way circumscribing the scope of my invention. Many other modifications will be apparent to those skilled in the art and my invention, therefore, is not to be limited except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. An as element of a resistor device, a particle of inert, substantially non-conductive filler material, a coating of insulating material thereon, and a film of conducting material upon the outer surface of the insulating material.

2. As an article of manufacture, a resistor composed of particles of inert filler, substantially all of said particles being respectively coated with an insulating material carrying an outer film of conducting material, the films of conducting material being in intimate contact with each other throughout the mass of said resistor.

3. The invention set forth in claim 2, wherein the insulating material is a polymerized phenol formaldehyde resin.

4. The invention set forth in claim 2 wherein the conducting material films are bonded together into a quasi-honeycomb structure.

5. The process of manufacturing a material from which resistors may be formed which comprises coating a plurality of particles of inert material with an insulating layer and thereafter depositing a conducting surface film upon substantially all of said particles.

6. The process of manufacturing a material from which resistors may be formed which comprises coating the surface of a plurality of particles of inert filler material with a polymerizable material, and thereafter causing a film of conducting material to be deposited upon the surface of the polymerizable coating.

7. The method of manufacturing a material from which resistors may be formed which comprises mixing a mass of inert material particles with a solution of a polymerizable material in a volatile solvent, causing the solvent to evaporate and then applying to the surface of substantially all of said particles an adherent coating of conducting material.

8. The invention set forth in claim 7 characterized in that the inert material is a mixture of asbestos particles and ground glass.

9. The method of manufacturing a material from which resistors may be formed which comprises moistening a mass of air-floated asbestos with a solution of a phenol formaldehyde resin in a volatile solvent, causing the solvent to evaporate, mixing the residuum with a colloidal suspension of carbon, causing the carbon to be precipitated from the suspension onto the surfaces of substantially all of the particles of asbestos, and thereafter removing the remaining solute.

10. The method of manufacturing fixed resistors which comprises intimately mixing a mass of comminuted inert filler material with a solution of phenol formaldehyde resin in a volatile solvent, causing the solvent to evaporate whereby the resin is deposited as a coating upon the particles of filler, mixing the coated particles with a colloidal suspension of carbon, causing the suspension to coagulate to thereby precipitate the carbon onto the surfaces of the particles, removing the surplus vehicle of the suspension, molding the residuum into appropriate shapes, and thereafter baking the molded articles at a temperature sufficiently high and for a sufficient length of time to cause the resin to polymerize.

11. The invention set forth in claim 10 characterized in that the inert filler material is asbestos and ground glass.

12. The method of manufacturing a material from which resistors may be formed which comprises moistening a mass of inert filler particles with a solution of phenol-formaldehyde resin and a reagent capable of causing the coagulation of a colloidal suspension of carbon in a volatile solvent, causing the solvent to evaporate, and introducing the resin-coated filler particles into a colloidal suspension of carbon.

13. The method of manufacturing a material from which resistors may be formed which comprises moistening a mass of inert filler particles with a solution of phenol-formaldehyde resin and furfural in a volatile solvent, causing the solvent to evaporate, and introducing the resin-coated filler particles into a colloidal suspension of carbon.

14. The method of manufacturing a material from which resistors may be formed which includes moistening a mass of inert filler particles with a solution of a phenol formaldehyde resin and an organic acid dissolved in acetone, causing the solvent to evaporate, and introducing the resin-coated filler particles into a colloidal suspension of carbon.

15. A resistor element in the form of a rod constituted by a plurality of particles of inert filler, substantially all of said particles having a first coating of an insulating material and an outer coating of graphite and carbon black, the said particles being in such intimate contact with each other that a substantially uninterrupted electrically conductive path is established between the ends of the rod.

16. The method of manufacturing a resistor which comprises coating each of a plurality of particles of inert filler with polymerizable resin, superimposing a film of conducting material upon the resin coating, compressing the filmed particles into a coherent mass, polymerizing the resin coating to lock the particles in place and thereafter impregnating the mass with a moisture repellent material incapable of dissolving the polymerized resin at temperatures encountered during ordinary use of the resistor.

SIDNEY BLOOMENTHAL.

ll Laboratories October 1960

RECORD

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The Bell System uses some devices by the millions. Redesigning one of these devices to cut costs by even a small amount can result in important savings to the Bell System. A typical redesign of this kind, on a widely used power resistor, was recently completed at the Laboratories.

R. J. Wirtz

A New Design for Power Resistors

The complexity of a telephone system is due in part to the variety of equipment, devices, and materials it uses. Some of these items are relatively new to the arts of telephone switching and transmission. Germanium or silicon devices, for example, have only recently been incorporated into new designs to any extent. But many of the better known devices—resistors, capacitors, and inductors—have served the telephone system for a long time. Typical of these venerable units in the Bell System are the power resistors known by the code names "18 and 19 Flat-Type Resistors."

These resistors, associated with station apparatus and transmission and switching facilities, are categorized as "general use" items. As such, they have found numerous applications in the Bell System. The first designs were manufactured by the Western Electric Company as early as 1901. Because of their extensive use and unique appearance, flat-type resistors performed a very special service during World War II. At that time, they served to identify equipment manufactured by the Western Electric Company. This expedited a sizable sorting process on the invasion beaches of Europe. The 18- and 19-type resistors have an excellent record of past performance in the telephone plant and have earned the reputation of "old standby."

Physical Dimensions

These wire-wound resistors can dissipate approximately 5 watts of power under normal conditions, and as much as 12 watts, for limited periods, under trouble conditions. They are flat in appearance, measuring approximately ⅜-inch thick by 1¾-inches wide by 4¾-inches long. They can be mounted in banks on 7/16-inch-minimum centers. The 18-type resistors have a single winding and two rigid terminals, while the 19-type resistors have two windings and three rigid terminals. In 1959, demand in the Bell System for these Western Electric resistors was something over six million per year.

Obviously, such a high demand makes it worthwhile to attempt to cut down the cost of these resistors, if it can be done without sacrificing

R. F. Leach, left, and author discuss attributes of the new 19-type resistor. On display board at rear are variety of Bell System resistors.

quality. And so it was that these resistors were completely redesigned in a lengthy program combining efforts of both Bell Laboratories and Western Electric. This program was completed just a few years ago when initial production of the newly designed resistors began at the Kearny, New Jersey, plant of the Western Electric Company.

The primary objectives of this redesign were to eliminate various items of insulators and mounting hardware, and adapt the resistors for modern methods of production. Such factors contribute directly to a substantial reduction in cost, reflected partly in the unit cost of the resistor and partly in the cost of mounting or assembling it into equipment. Moreover, there is a long-term savings attributable to an improved product.

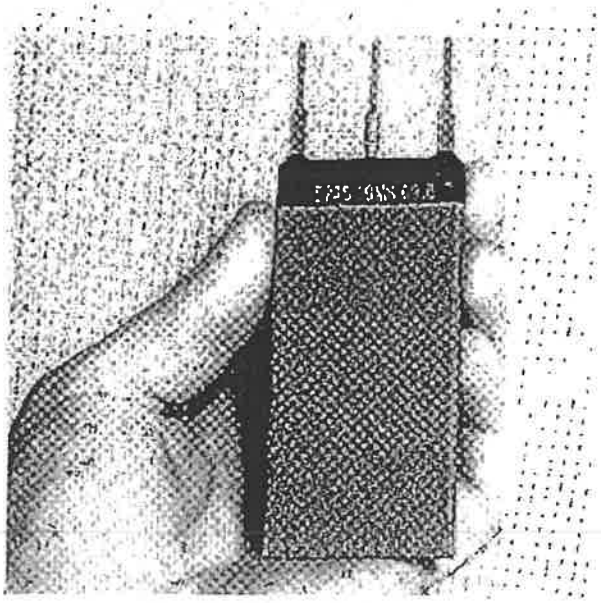
The improvements in design included three major items. First, designers superimposed windings on an insulated metal core and terminated the resistance wire by spot welding it to the core and terminal. Old-style resistors had windings side by side on a phenolized asbestos core with soldered splices and terminations.

Second, they provided an insulated mounting surface for the resistors by assembling a phenolic terminal head molded integrally with the metal core. The old designs required mounting-plate bushings, insulator washers on both sides of the mounting plate, and metal mounting washers.

Finally, the designers secured the new resistors to the mounting plate by a single, centrally located mounting stud for the 18-type resistors. This mounting stud doubles as the third terminal post for the 19-type resistors.

In addition, new design 18- and 19-type resistors have terminals to accommodate either soldered or solderless wrapped wire connections (RECORD, *February*, 1954). The entire body of the resistor is covered with an envelope of phenolized asbestos, completely insulating the structure on the apparatus side of the mounting plate. Old-style resistors had metallic terminal side posts exposed over the entire length of the body. Also, code and resistance-value markings on the new style are stamped on the molded head where they are legible when the resistors are mounted in place. This is in contrast to the old style markings that were printed on a label affixed to the resistor body, where they were unreadable when the resistors were mounted. As with the old style, the resistance-value markings for the 19-type resistor are oriented to identify unequal windings.

The new designs feature detail parts that lend themselves to be fabricated, machined, and assembled by modern production methods. This is especially true of parts such as a metal card that combines the core and the terminals. It is also true of the mounting stud and center terminal, and the molded-phenolic head unit and envelopes of asbestos that encase the resistors.



The redesigned 19-type resistor. Center mounting stud is designed to be a third terminal post.

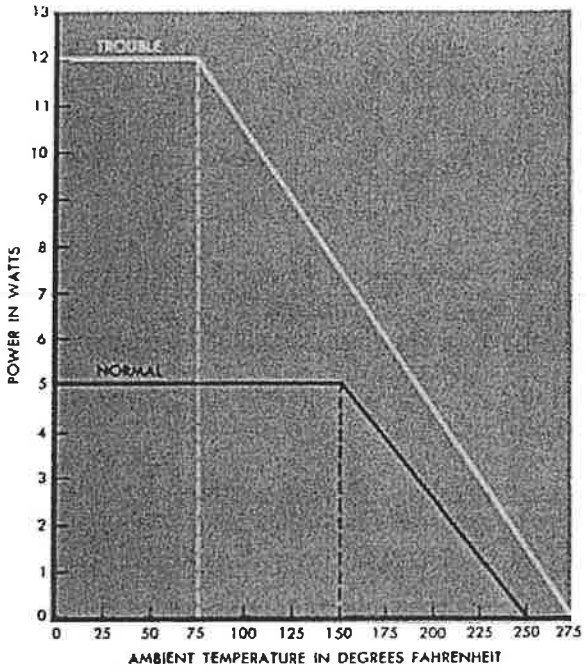
For a given power-dissipation, the operating temperature of the new resistor is lower than that of the old. This is because the metal core acts as a "heat sink," distributing the heat evenly over the entire body of the resistor. The result is lower "hot-spot" temperatures. Based on experimental data, power rating characteristics were derived for the new resistors. These are illustrated in the graph, right. Here, the "normal" power rating is 5.1 watts. For each degree that the ambient temperature exceeds 150 degrees F, the rating decreases about one per cent of the normal rating, or about 1/20th of a watt. "Trouble" power rating is shown as 12 watts with a decrease of about one-half of one per cent, or 1/16th of a watt, for each degree the ambient temperature exceeds 75 degrees F. A trouble condition is a temporary overload condition due to a circuit malfunction. Resistors can be operated at "trouble" power ratings safely for twenty-four hours.

At the time redesigns were contemplated, there was a large quantity of old-style resistors already in the field. It was essential, therefore for the new styles to be designed electrically and mechanically interchangeable with the old. For this reason, the new designs were tailored to have their over-all function and appearance governed by the electrical characteristics and physical dimensions of the old-style resistors.

Electrical Protection

Because of their completely insulated structure, the redesigned resistors have no "live" parts behind the panel on which they are mounted. Therefore, they do not require the insulators and shields normally used on the old-style resistors for electrical protection against the exposed metal side posts and the center post.

The new designs have their terminal insulation integral with the molded head. This eliminates the need for mounting-plate bushings, used for insulating old-style resistor terminals. In the event of a field replacement (where a new-style resistor replaces an old) the bushings must be removed before the new resistor is mounted. With the introduction of the redesigned resistors, the now obsolete insulator bushings are no longer being supplied in newly manufactured mounting plates. Thus, to maintain interchangeability, designers had to devise a way of mounting old-style resistors in the unbushed holes of these new mounting plates. They therefore supplied a new molded-strip insulator to take the place of the bushings. For additional economy, this insulator also replaces two insulating washers



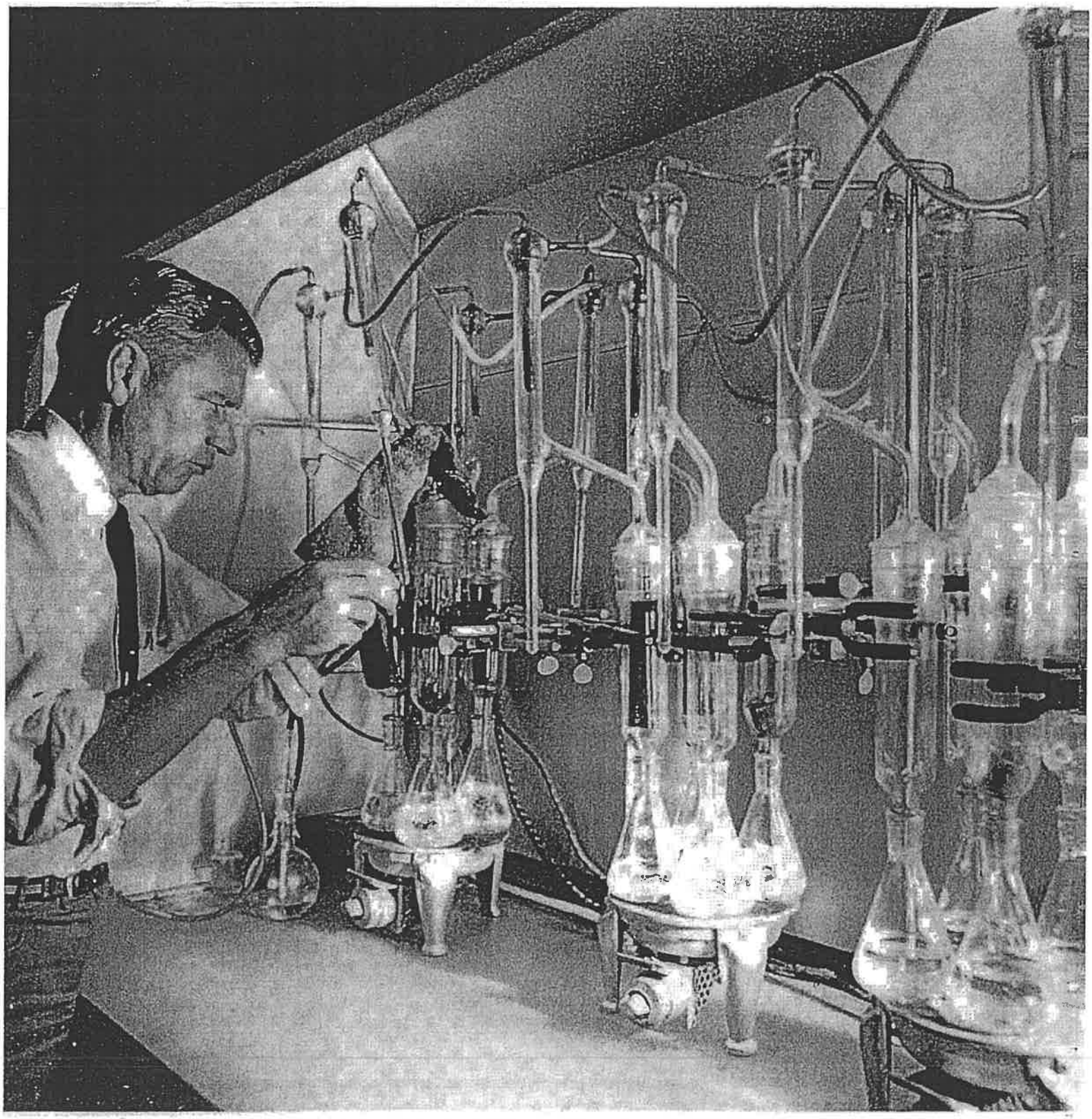
Power rating characteristics of the new resistors show "normal" at 5.1 watts, "trouble" at 12 watts.

formerly required on the apparatus side of the mounting plate.

Since the new designs are electrically interchangeable with the old, the Bell System has retained the old code designations. This has avoided the expense of a substantial amount of drafting, clerical, and engineering effort that otherwise would have been involved in changing an estimated 100,000 drawings—Bell Laboratories equipment and circuit drawings as well as Western Electric Company equipment drawings and wiring diagrams.

During the period from initial to full-scale production of the new design, the Western Electric Company produced both new- and old-style resistors. However, production of the old style was reduced progressively until today, all requirements for 18- and 19-type resistors are being filled with the new design.

In its redesign program, the Bell System reviews long-existing items and judges them in the light of their present use. It also takes a close look at their quality and reliability requirements, and at their methods of manufacture. Effort devoted to this type of review results in the improvement of components. And for those manufactured in a large volume, such as the 18- and 19-type resistors, it can save much money for the Bell System.



John Leutritz places a wire-mesh basket containing wood wafers into a flask of boiling toluene. As the vapors pass through the wafers, the preservative is removed, and signs of decay can be seen.

RESISTORS

Enameled Resistor Units, CR9006

Form QL

The QL unit has stranded-copper leads for [illegible] external connections.

Form QD

The QD unit has stranded-copper leads, and porcelain bushings at each side mounting.

Form QC

The QC unit is designed for [illegible] mounting. The leads are connected to the metal [illegible].

Form QS

The QS unit is provided with a screw base, for mounting in lamp sockets. The [illegible] unit has a candelabra base, and the [illegible] unit has a standard Edison base.

Form QF

The QF unit is provided with metal feet to which the leads are connected, and through which the external connections are made.

CR9006 enameled resistor units consist of resistance wire, [illegible] compound bodies and enameled. The units [illegible] up to five forms, as illustrated.

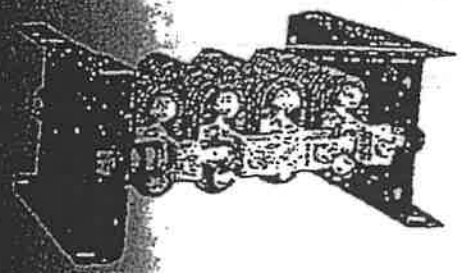
[illegible] employ a strong, high-heat-resisting [illegible] compound body, developed to withstand sudden and extreme [illegible] changes without injury. The resistance wire has [illegible] temperature coefficient, so that the resistance remains [illegible] constant, regardless of the temperatures.

The wire, after being wound on the body, is embedded in a blue vitreous enamel, which is fused at a high temperature to a uniform, glassy structure. The enamel is moisture-proof and extremely durable, and forms a mechanically strong and airtight casing for the resistor windings. It aids materially in the dissipation of heat.

For prices and ratings, refer to nearest sales office.

Edgewise-wound Resistors, CR9132

Corrosion-resisting, Unbreakable



CR9132 four-unit edgewise-wound resistor

end frames to provide a four- or a six-unit box. This type of resistor is especially adapted to withstand severe vibration and exposure, as it is unbreakable and the resistive material is resistant to corrosion. The resistors are light in weight, and the unbreakable feature prevents losses resulting from breakage in shipment and in service.

The CR9032 edgewise-wound resistor unit consists of the following:

1. Two steel punchings held firmly together, but insulated from each other by a heat-resisting compound known as "Electrobestos X."
2. Sheets of fired alumina, which insulate the resistive conductor from the support.
3. Edgewise-wound, stainless-steel ribbon, wound in an elliptical shape to conserve space and permit the use of a greater active length of ribbon.

A copper connector silver-brazed to each end of the resistive conductor permits bolting the extreme end of the resistive material to the support. The ends of the supports, together with clamps, provide ideal rigid terminals for interconnections between units or for main leads to the resistor.

For prices and further details, refer to nearest sales office.

[illegible] particularly recommended for use on [illegible] portable equipments, steel-mill auxiliaries, [illegible] shocks and vibrations are encountered. [illegible] CR9032 edgewise-wound units clamped [illegible] insulated tie rods and mounted in suitable [illegible]

Resistors—CR9133

Smooth-, Open-, and Edgewise-wound

FEATURES

[illegible] very strong.

[illegible] Select [illegible] corrosion-resistant.

[illegible] extremes.

[illegible] ends on readily accessible terminals.

S Effective heat dissipation aided by unrestricted natural draft

9 Minimum number of current-carrying connections

10 Low resistance, strong silver-brazed terminals

11 Permanent electrical characteristics

12 Practically unbreakable construction

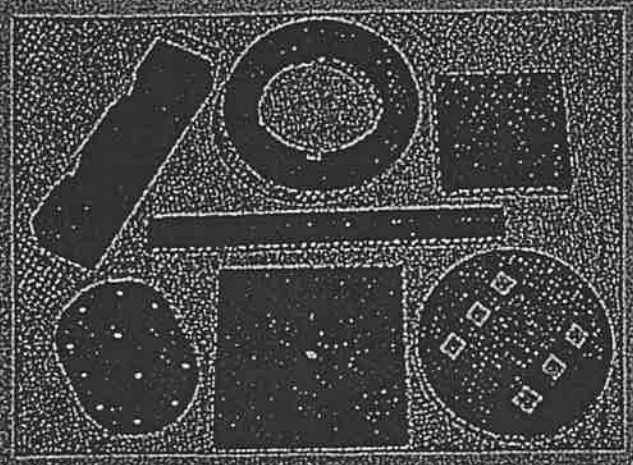
For industrial control publications, see pages 172 and 173

[illegible] ELECTRIC

electrobestos

Asbestos Ebony Moulded and Electrobestos

In many industries the introduction of moulded shapes has simplified the assembly of units and effected important production economies. Two such custom-moulded materials which have wide adaptability are Asbestos Ebony Moulded and Electrobestos. Asbestos Ebony Moulded is primarily an electrical insulation. Electrobestos is most commonly used where high heat resistance is needed. Both materials afford considerable saving, especially when thick, heavy pieces of simple design are involved.



Asbestos Ebony moulded parts used in electrical service

Asbestos Ebony Moulded

Asbestos Ebony Moulded is an excellent electrical insulation which is extensively used, principally, where small panels, bases or plates are required for switches, starters, meters and similar units. It is black in color and makes a very presentable appearance.

The material is formed under heavy pressure from a mixture of asbestos fibre and binding cement and is impregnated with a special insulating compound. The finished product is electrically and mechanically strong. It will not absorb moisture nor deteriorate with age, and it will successfully withstand the action of ordinary laboratory acids. The material is suitable for working temperatures up to 300 deg. F.

Electrobestos

Electrobestos is a grey-and-white material which is widely used for arc or flame barriers and for parts of small ovens, muffles, or other apparatus exposed to heat. This material, however, is not recommended for the mounting of current carrying parts.

Two kinds of Electrobestos are available. Where the material combining moderate structural strength with great adaptability to temperature changes is required, plain Electrobestos should be specified. Electrobestos X, a slightly harder material, possesses greater structural strength, but offers slightly less resistance to the stress of expansion and contraction under sudden temperature changes.

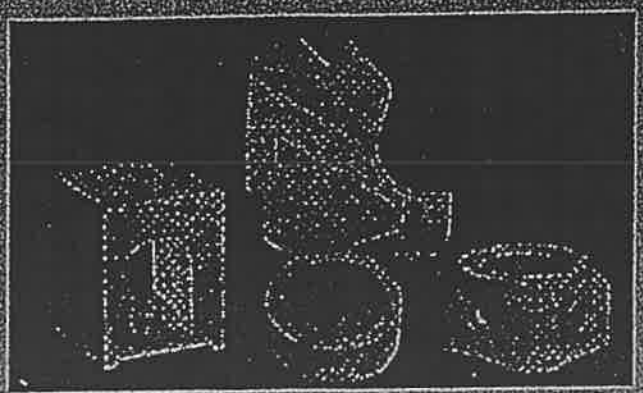
Electrobestos is composed of asbestos fibre and high temperature clays moulded to shape in a cold plastic mass, impregnated with a liquid binder and heat treated. It has been used in many applications under steady or intermittent heat up to 1,200 deg. F.

Sheets: Electrobestos is available in sheet form, up to 36" x 30", in thicknesses of ¼" to 1½" inclusive. Sheet Electrobestos is made by a slightly different process than that used for moulded shapes and, consequently, varies from them in some properties. Its heat resistance is approximately 800 deg. F. (Note: Electrobestos X is not furnished in sheet form.)

Muffle Furnace Trays: Where enameling or vitrifying processes are carried on in muffle furnaces, the use of Electrobestos trays usually shows a saving. The trays can be furnished to size up to 30" x 30".

Panels: Holes, slots, grooves, bosses and characters can be inexpensively included on panels. Dimensions are shown under "Design Possibilities."

Arc Deflectors: Its high resistance to the deteriorating effects of constantly arcing contacts makes Electrobestos eminently suitable for use in the form of arc deflectors. Moulds for many styles of deflector plates are carried in stock. Special shapes can be furnished from blueprint or model.



A few of the many moulded pieces made of Electrobestos

Printed in U.S.A.

EXHIBIT F

ASBESTOS

Asbestos is used in many varied forms such as board, cloth, fiber, rope packing, sleeving, tape, twine, yarn, sheet, and in other numerous combinations. The manner of storage depends upon the form of asbestos. Where the asbestos may possibly be in a loose form during storage, a dusty condition could be produced and proper ventilation should be provided.

PROPERTIES

FIRE - Non-flammable.

EXPLOSION - Non-explosive.

BREATHING - Dust from asbestos materials may produce a chronic lung disease if it is breathed in sufficient concentrations over a period of years. In some persons, the disease may develop much more rapidly than in others. The concentration and particle size of the dust will also influence the number of years of exposure required to produce the disease. In any case, exposure even to high concentrations of asbestos dust for a period of a few days or even a few months will not produce the disease. Particles larger than about 10 microns (0.000039 in.) cannot get into the small lung air sacs to cause damage. Such small particles are far below the size which is visible to the naked eye. Most dusts, however, have particles of a large range of sizes which vary from visible to invisible. It is only the fine invisible dust particles that are effective in producing asbestosis.

Where people may breathe the dust, the Maximum Allowable Concentration is 5 million particles per cubic foot of air, unless the exposure is for less than one hour per day, in which case a slightly higher concentration may be permitted but must not exceed 10 million particles per cubic foot. These Maximum Allowable Concentrations apply to repeated or recurring daily exposures. Where asbestos may be mixed with other less harmful dusts, the concentration of asbestos dust will be the controlling factor. The asbestos dust concentration can be determined by collecting and analyzing air samples.

SKIN IRRITATION - Asbestos is usually not a skin irritant.

PERSONAL PROTECTIVE EQUIPMENT

WHEN IT IS NECESSARY TO WORK IN AN AREA CONTAINING HIGH DUST CONCENTRATIONS, AN AIR-LINE RESPIRATOR OR HOSE MASK WITH OR WITHOUT A BLOWER MAY BE USED. The air-line respirator should have 8 to 15 lbs/sq.in. pressure. Care should be taken so that contaminated air does not enter the hose for the hose mask.

For medium dust concentrations, the standard all dust respirator 8883-5, equipped with filter 8883-6, may be used. Filters should be replaced according to a predetermined schedule or at any time breathing becomes difficult.

All respirators and replacement parts should have the Bureau of Mines approval which is indicated by a label on larger parts or BM#_____(approval number) on smaller parts.

PRECAUTIONS

A PERSON SHOULD NOT ENTER AN AREA CONTAINING AN EXTREMELY HIGH CONCENTRATION OF ASBESTOS DUST FOR A PROLONGED PERIOD OF TIME WITHOUT ADEQUATE PROTECTION. THE MAXIMUM ALLOWABLE CONCENTRATION

ASBESTOS (Continued)

OF 5 MILLION PARTICLES OF DUST PER CUBIC FOOT OF AIR SHOULD NOT BE EXCEEDED FOR REPEATED OR CONTINUOUS EXPOSURES. THIS MAY BE ACCOMPLISHED BY COMPLETELY ENCLOSING THE SYSTEM OR BY PROVIDING ADEQUATE VENTILATION. PROPER PREPLACEMENT AND PERIODIC PHYSICAL EXAMINATIONS SHOULD BE MADE BY THE MEDICAL DEPARTMENT ON PERSONS WHO WORK WHERE THERE IS REPEATED OR RECURRING EXPOSURE TO ASBESTOS DUST.

WHEN IN DOUBT
CONSULT MEDICAL OR SAFETY DEPARTMENT

East Pittsburgh, 2-0-46
Industrial Hygiene Laboratory

June 11, 1954

SOUTH PHILADELPHIA WORKS
Industrial Relations
Mr. W. E. McKeldin
Safety Supervisor

With respect to the room in which asbestos cloth is being cut and sewed, the air samples did not indicate exposure to concentrations of asbestos dust above 5 million particles per cubic foot, which is presently regarded as the maximum allowable concentration. However, I have a feeling that these concentrations may vary from time to time in the room. It would be very desirable to ventilate the room more effectively so that the amount of asbestos dust in the breathing atmosphere would be further reduced. When sheet material is being thrown from one bench to another, the concentrations of asbestos fibers in the breathing atmosphere of the sewer in particular would appear to be potentially hazardous. As you know, in the State of Pennsylvania, when a person's chest contains some silicosis and it becomes superimposed with tuberculosis, that this disease becomes compensable. I believe that the same is true in the case of asbestosis. Frequently, the early stages of asbestosis or silicosis are difficult to detect by X-rays and it is also believed that persons suffering from beginning stages of asbestosis or silicosis are more likely to develop tuberculosis. We have such a case in Compensation Court from one of our plants at the present time and they are difficult cases to handle.

As you know, the present fan in the side wall of this room is quite noisy and the men do not operate it more than necessary on account of the noise situation. Therefore, the ventilation of this room should be reconsidered. In the revision of the ventilation of this room, it might be most desirable to have the fan placed on the side of the room with the large number of windows since a good portion of the dust already is moving in this direction. It would be desirable to use a different type of fan in the improvement of this room. By placing the fan on the side wall presently containing most of the windows, the dust fibers collecting along this side of the wall would be ventilated to the outside of the building rather than dragged past the breathing level of the men doing the sewing.

I will greatly appreciate knowing what your final decision on this problem will be.

H. Wilbur Spelsberg, Administrator
Industrial Hygiene

P.S. These dust samples were found to contain quite many fine particles which would indicate their being more hazardous.

WHS

Westinghouse

DN 65711AA-AJ - PD SPEC (PDS) -
RL Rev W
DA Mar 5, 1978

TI CABLE, ASBESTOS INSULATED

CA CAUTION: CUTTING OR MACHINING WILL PRODUCE ASBESTOS DUST. DUST SHALL NOT BE BREATHED. ADEQUATE LOCAL EXHAUST VENTILATION SHALL BE PROVIDED. SEE SPDS A-20.

SU SUPPLIERS:

(65711AA)		A-B-D-E-F-G
(65711AB)		A-B-C-D-E-F-G
(65711AC)		C-D
(65711AJ) (All Plants except Elevator)		A-B-D
(Elevator)		A-B-D-H

(A) Carro Wire and Cable Co (Carro) 550 Nicoll St, New Haven, CT 06504
(B) Coleman Cable Co, 1900 N Fifth Ave, River Grove, IL 60171
(D) Continental Wire and Cable Corp (Anaconda) Gelson Rd, York, P 17404
(E) Okonite Co, PO Box 340, Ramsey, NJ 07446
(F) Phelps Dodge Cable and Wire Co, Foot of Point St, Yonker, NY 10702
(G) Radix Wire Co, 25242 Lakeland Blvd, Cleveland, OH 44132
(H) United States Steel Corp (Wire and Cable Div) Ballard St, Worchester, MA 01607

OR ORDER FROM SUPPLIER AS: Cable (or Wire), stating P D Spec Number and Rev Letter.

CH CHARACTERISTICS:

Grade	Previous Grade	Users	Insulation	Treated Braid
65711AA	7419-2	BG BS EP JC MAR SDD	VC & Asb	Asb
65711AB	7419-3	BG BS EP JC LAE PT PTE SH	Asb	Asb
65711AC	7419-4	ME	Asb	Asb
65711AD	7419-5		Obsolete.	
65711AE	7419-8		Obsolete.	
65711AF	7419-12		Obsolete.	
65711AG	7419-15		Obsolete.	
65711AH	7419-16		Obsolete.	
65711AJ	7419-1	BE BG BS EP JC ME SDD	VC & Asb	Cotton

03144216

[redacted]

Grade	Braide Color	Type	Voltage*
65711AA	Black	AVA	600
65711AB	Black	AIA	600
65711AC	Black	AIA	600
65711AD			
65711AE			
65711AF			
65711AG			
65713AH			
65711AJ	Gray	AVB	600

Tinned copper wire, except 65711AB has untinned conductor
* Unless otherwise specified.
# Contains fungicide.
Circuit voltage, phase to phase.

AP APPLICATION:
(65711AA,AJ) Switchboard and control wiring.
(65711AB,AC) Appliance leads; general use.

CP CORPORATE PART NUMBER: PDS No. + Size Code
Example: 65711AA5GL (CABLE - If reference name is desired)

FSCM 79800

03144217

PDS 42331AA thru AC Rev AA Jul

ASBESTOS PAPER
CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WI
LOCAL EXHAUST VENTILATION. SEE SPDS A-20.
SUPPLIERS -

(42331AA)	(Except .007" & .010" thk)	A-B
	(.007" thk only)	B
	(.010" thk only) (Except HA)	B
	(For HA)	A-B

(A) Johns-Manville, Greenwood Plaza, Denver, CO 80217
(B) Nicolet, Inc, Wissahickon Ave, Ambler, PA 19002

ORDER FROM SUPPLIER AS - (42331AA) Paper, P D Spec 42331AA Rev AA.

CHARACTERISTICS - 42331AA (Previous 2118-1) (Users:AMD,BE,BG,BM,EMM,DA,EP,HA,M&R,PT,SH,S
Commerical grade asbestos paper of uniform quality.
42331AB (Previous 2118-2) Obsolete.
42331AC (Previous 2118-3) Obsolete.

For properties & dimensions see PDS.

APPLICATION - General use.

SPECIFY BY - CODED IDENT (PDS No. + Size Code)
Example: 42331AA3GD (ASB PAPER - If reference name is desired)

MOLDED PARTS, CALCIUM SILICATE-ASBESTOS
CAUTION: MACHINING PRODUCES ASBESTOS DUST. DUST SHALL NOT BE BREATHED. ADEQUATE LOCAL EXHAUST VENTILATION SHALL BE PROVIDED. SEE SPDS A-20.
SUPPLIERS - American Insulator Corp, 1930 Main St, New Freedom, PA 17349

ORDER FROM SUPPLIER AS -
(46316AJ,AL,AM) AICO 5, stating drawing and item number.
(46316AK) AICO 5 plus 1.5% Carbon Black, stating drawing and item number.

CHARACTERISTICS - 46316AJ (Previous 161-1)(User:BG) White, inorganic, cold molded composition consisting of calcium silicate and asbestos, having properties as follows:

Tensile Strength, Psi	2200
Compressive Str, Psi	10910
Flexural Strength, Psi	3783
Impact Str, Ft-Lb/In-Notch	.46
Dielectric Strength, VPM	43
Arc Resistance, Sec	556
Heat Resistance, F	1000
Specific Gravity	1.84
Moisture Abs, 24 hr, %	4-13

CANCELLED
CV 20-84

46316AK (Previous 161-2)(User:BG) Same as 46316AJ except black. Contains 1.5% carbon black.
46316AL,AM (Previous 161-3,-4)(User:BG) Same as 46316AJ except for specific applications.

APPLICATION - (46316AJ) Intricate inorganic cold molded parts.
(46316AK,AL) Cold molded parts such as arc boxes.
(46316AM) Cold molded insulating spacers for rotary switches.

SPECIFY BY - CODED IDENT (M No.)
Example: 46316AJ (SILICATE ASB - If reference name is desired)

Printed in U.S.A. W Corp Std R&D (Fed. CODE IDENT NO. 79500)

30071419

M 41521CC Rev B OBS./CANCELLED 5/5/78 Jul 5, 1976

CLOTH, ASBESTOS, SILICONE VARNISH TREATED

CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WITH ADEQUATE LOCAL EXHAUST VENTILATION. SEE SPDS A-20.

CONVERTED TO SUPERSEDED BY.....

SUPPLIERS - Westinghouse Electric Corp, IMD, Bedford, PA 15522

ORDER FROM SUPPLIER AS - Treated Cloth 41521CC*

*Stating "Permanently mark all containers with Westinghouse M number."

CHARACTERISTICS - (Previous 1296-1)(User:M&R) Asbestos cloth 41511BB treated with silicone varnish 32102FH.

APPLICATION - Armature insulation.

SPECIFY BY - CODED IDENT (M No. + Size Code)
Example: 41521CC1JX (TR ASB CLOTH - If reference name is desired)

Printed in U.S.A. W Corp Std R&D (Fed. CODE IDENT NO. 79500)

DN [redacted] - PD SPEC (PDS) -
RL Rev A
DA Jul 5, 1976

-

TI ASBESTOS TAPE, WOVEN

-

CA CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WITH ADEQUATE LOCAL EXHAUST VENTILATION. SEE SPDS A-20.

-

SU SUPPLIERS:
(A) Amatex Corp, 1030 Stanbridge St, Norristown, PA 19404
(B) Atlas Textile Co, 538 Walnut St, North Wales, PA 19454
(C) H K Porter, Inc, 1000 Seaboard St, Charlotte, NC 28206
(D) Raybestos-Manhattan, Inc, 100 Oakview Dr, Trumbull, CT 06611
(E) Uniroyal, 1230 Ave of Americas, NY, NY 10020

-

(.010" thk)	A-B-E
(.015", .025" thk)	A-B-C-D-E

-

OR ORDER FROM SUPPLIER AS: Tape, P D Spec 41511AA Rev A.

-

CH CHARACTERISTICS: (Previous 1598) (Users: BM EP JC MAR PT SH) Closely woven, unsized asbestos tape, .010", .015" and .025" thk. Tape .015" thk and over is constructed of asbestos yarns, both warp and fill, which may contain 20% (max) cotton. Tape .010" thk contains in addition to asbestos warp yarns two cotton threads at each edge and filler is of fine cotton yarn. Cotton content of asbestos warp threads is approx 17% and total percentage of cotton is approx 27%.

-

For additional properties and construction details see PDS.

-

TL TOLERANCES: See PDS

-

EQ EQUIVALENTS(ref only): MIL-I-3053, tape. grade U.G., type 2PU

-

TRADENAMES: MIL I 3053 GR U G TYPE 2PU

-

AP APPLICATION: Taping TI 130 armature coils.

-

CP CORPORATE PART NUMBER: PDS No. + Size Code
Example: 41511AA1BM (ASB TAPE - If reference name is desired)

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DN 42231AA-AB - PD SPEC (PDS) -
RL Rev D
DA Jan 20, 1977
-
TI ABESTOS PAPER
-
CA CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WITH ADEQUATE LOCAL EXHAUST VENTILATION. SEE SPDS A-20.
-
SU SUPPLIERS:
(42231AA) Johns-Manville, Greenwood Plaza, Denver, CO 80217
-
OR ORDER FROM SUPPLIER AS: (42231AA) Paper, P D Spec 42231AA Rev D.
-
CH CHARACTERISTICS: 42231AA (Previous 4262-1) (User: BM BMM CL EP M&R TM) High grade asbestos paper composed of nonferrous type asbestos fiber specially manufactured to be free from conducting particles. It is much freer from conducting particles than commercial asbestos paper 42331AA and is considerably more expensive.
-

Thk, Inch.	Tens Str, Min (Lb/In Width)		Tear Str, Min (Gm/In. Width)		Apparant Density Grams/cc		Basis Weight, Lb/100 Sq Ft	
Nom	MD	CMD	MD	CMD	Min	Max	Min	Max
0.005	12	7	20	28	.65	.91	1.7	2.3
.0065	15	9	28	39	.76	.89	2.4	3.1
.007	17	10	29	40	.69	.95	2.9	3.5
.010	20	12	40	47	.67	.92	3.6	4.8
.015	23	13	62	77	.69	.94	5.5	7.5

-
42231AB (Previous 4262-2) Obsolete.
-
TL TOLERANCES: See PDS
-
EQ EQUIVALENTS(ref only): MIL-I-3053, type 2PU
TRADENAMES: MIL I 3053 TYPE 2PU QUINORGO 4000
-
AP APPLICATION: Treated with shellac for field coil insulation.
-
CP CORPORATE PART NUMBER: PDS No. + Size Code
Example: 42231AA18Q (ASB PAPER - If reference name is desired)
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1942

COMMONWEALTH OF PENNSYLVANIA

HON. ARTHUR H. JAMES, GOVERNOR

Department of Labor and Industry

Lewis G. Hines, Secretary

SAFE PRACTICE BULLETIN

No. 84

Occupational Disease Prevention

EXHAUSTING ASBESTOS FIBER AND DUST

IN

WIRE INSULATION MANUFACTURE

Deputy Secretary

Department of Labor and Industry

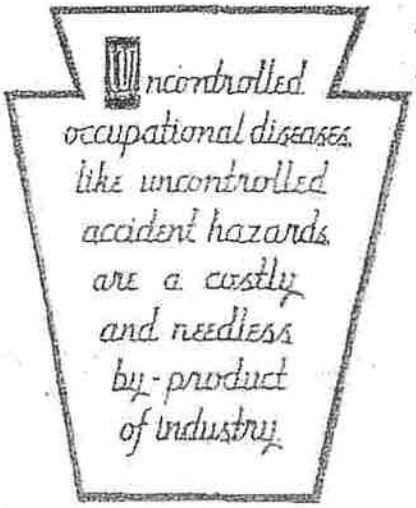
Frank K. Beal

Director

Workmen's Compensation Bureau

Wm. H. Chesnut

APRIL 1942


Uncontrolled occupational diseases, like uncontrolled accident hazards, are a costly and needless by-product of industry.

EXHAUSTING ASBESTOS FIBER AND DUST

IN

WIRE INSULATION MANUFACTURE

Edited by:-

Robert L. Houtz,
Industrial Chemist

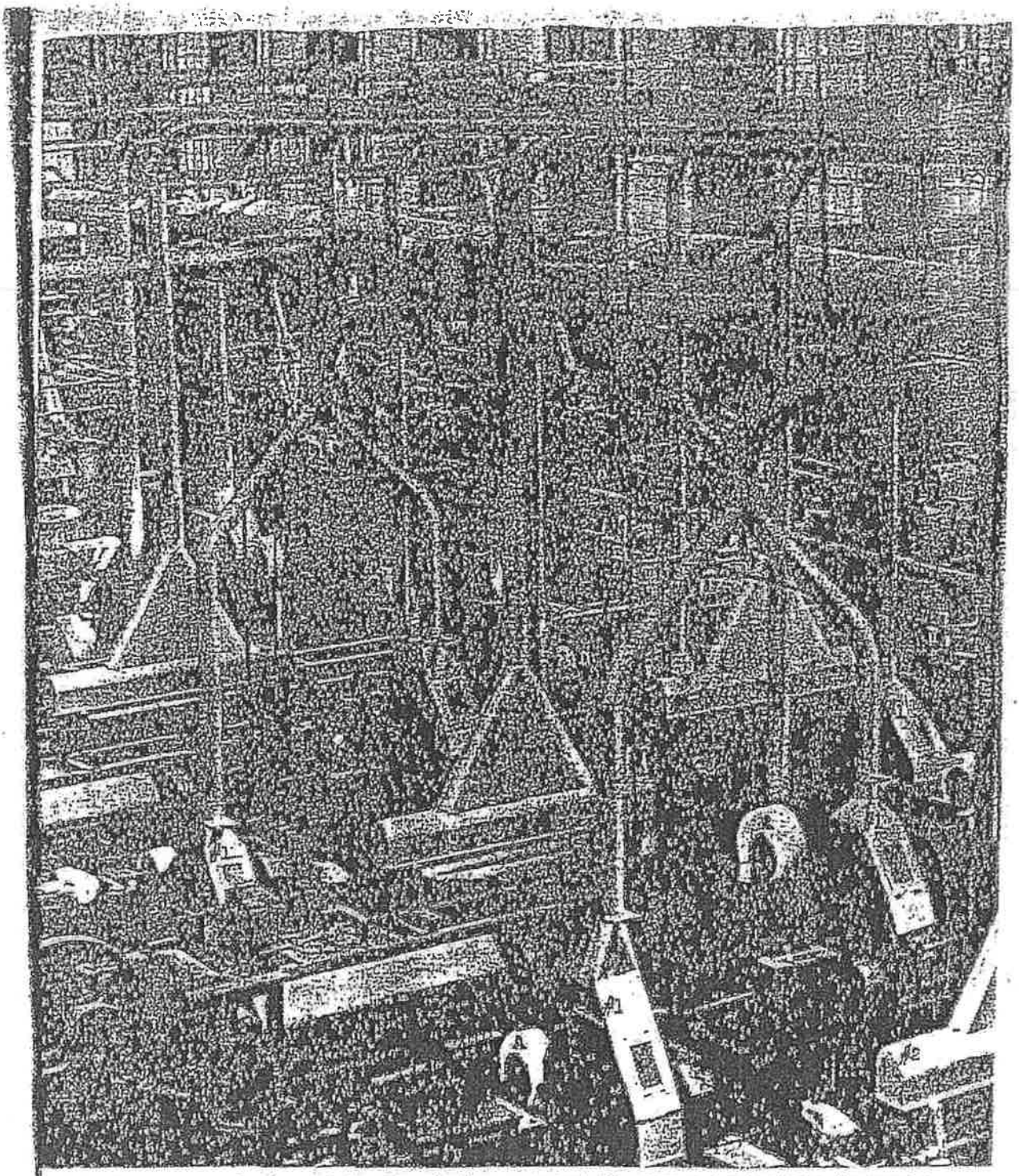
When asbestos is used as an insulation agent in the manufacture of wire it enters the plant in a refined form, having been through a previous manufacturing or processing treatment at some asbestos factory, which has conditioned the raw supply of asbestos.

Thus we find two general types of asbestos supply, one the yarn of asbestos in the spool form (to be used for braiding the outside of the finished wire), and the other the batt, or lap, form of asbestos which is loosely wound in a reel (this is the form that is used on the carding machines). High grade asbestos, of long staple and free-from-iron content, is used in wire manufacture intended for electrical insulation.

The wire manufacturer is more concerned with removal of a rather long-stapled waste, than the finer dust particles which are found associated with asbestos-ore processing about the picker-carding machine for example.

However, this asbestos by-product, if allowed to escape into the workroom, would soon float into the far boundaries of the plant and hang like Spanish moss, even from the rafters, and settling on belts, pulleys and equipment. It soon gets beyond the control of good housekeeping if unremoved at its origin. Asbestos has a decided abrasive action and its presence is not beneficial to the long life of plant equipment with which it comes in contact.

The plant procedure of the General Electric Company's wire works at York, Pennsylvania is considered a model in its asbestos waste removal system, and an illustrated description of the processes used, makes up the basis of this Safe Practice Bulletin.



This is a general view of the insulating room of the General Electric Company's Wire Works plant at York,Penna. The asbestos carding machine ventilating hoods are indicated by #1, with the white reel of asbestos felt , marked "A".

The larger ventilation hoods, marked #2 are to carry away the volatile fumes of alcohol-base solvents used in lacquers for the wire, and are over the drying ovens.

This general type of machine is known as M-Machine. This turns out magnet wire for motors and generators, and electric railways. The asbestos dust is delivered to the Langhorn Dust Collector, and this system is independent of the one for alcohol fumes.

The following illustrated talk was presented by Fred R. Kaimer, at a monthly safe practice conference sponsored jointly by Pennsylvania State College and the State Department of Labor and Industry. This conference was held at the Nittany Lion Inn and was under the joint chairmanship of Dr. Frank C. Whitmore, Dean of the School of Chemistry and Physics of the College and Mr. William H. Chesnut, Director of the Bureau of Workmen's Compensation.

EXHAUSTING ASBESTOS FIBER AND DUST IN WIRE INSULATION MANUFACTURE

by

Fred R. Kaimer,

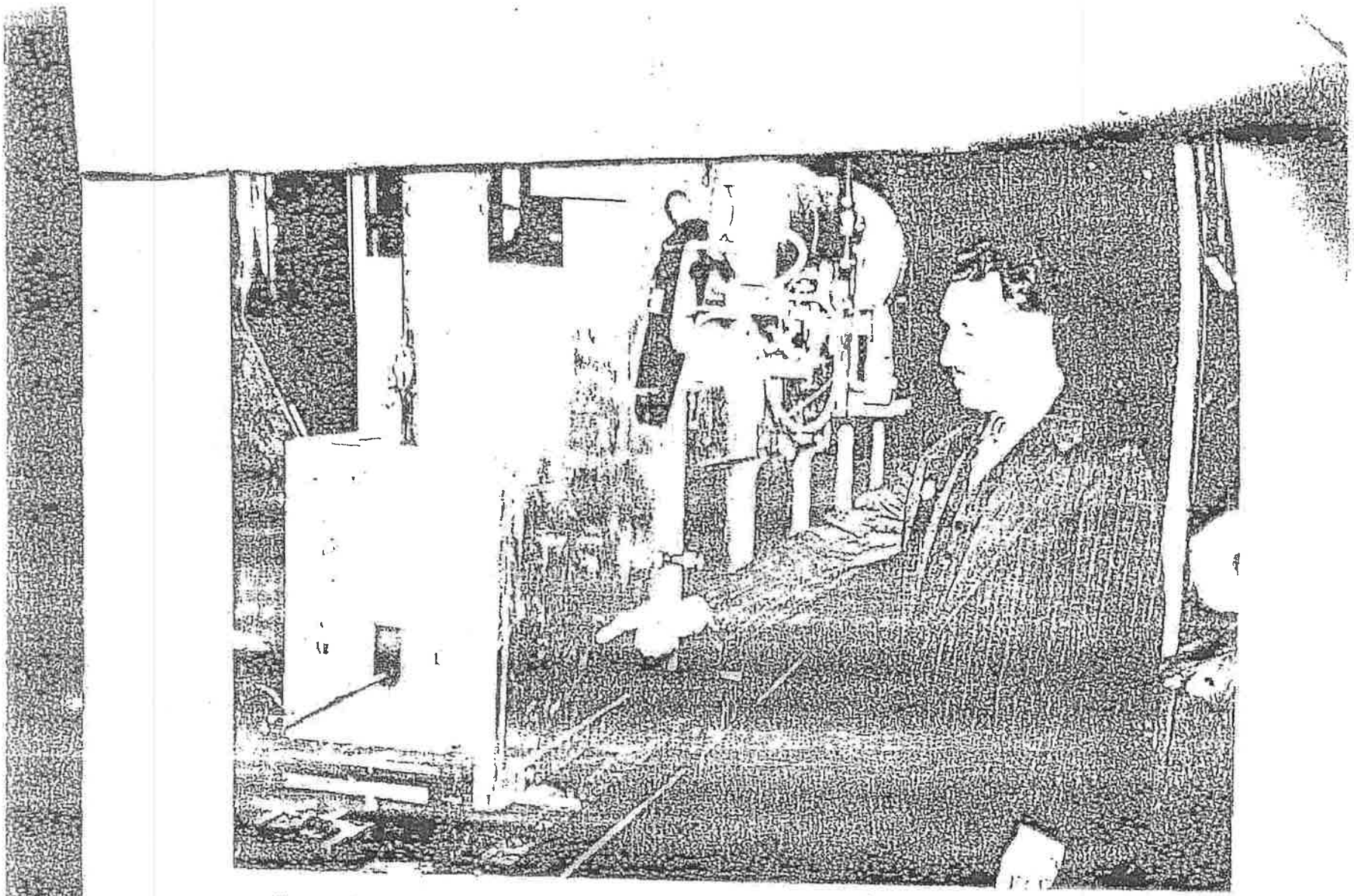
Assistant to Manager

General Electric Co. York Works

The use of asbestos fiber in the manufacture of insulated wire usually introduces a dust control problem which may require attention either as a potential dust hazard, a housekeeping problem or both. These conditions depend upon the quality and grade of fiber used, the form in which it is applied and the method of applying the insulation material.

The York Works of the General Electric Company includes in a complete program of control not only the essential exhausting and collecting equipment for controlling the asbestos fly and dust at its source, but a routine inspection and continuous maintenance of all systems, a periodic check of air conditions, thorough physical examination of all new employees and re-examination periodically for all employees.

The success of this program depends upon the uniform stress placed upon each unit of precautionary measure. The employee, as well as the employer, share a definite responsibility to insure safety, improved health and better working conditions.



The author of this bulletin is Mr. Fred Kalmer, who is general manager of the York Wire Works division of the General Electric Company plant at York, Penna. and who is shown standing beside a drying oven, where the solvent alcohol is removed, through the agency of gas fires and ventilation, together with mechanical inclosure. This is an M-Machine and handles the larger diameter wire, usually copper, ranging from 2 gauge (0.114 in.) to 0000 gauge (0.460 in.), American wire standards. The magnet wire is observed as entering the inclosure from the left side through the opening. (In a previous bulletin, Safe Pract. Bulletin 221, Mr. Kalmer has described: Insulation of Wire with Synthetic Wax. Illustrated)

A brief outline of the method employed in asbestos wire manufacture is essential to qualify some of the illustrations and clarify the mechanics of asbestos fiber removal and collection.

"Deltabeston" the General Electric Company's trade name for asbestos insulated wire, comprises an insulating fiber of the crysotile variety $H_4M_{93}Si_2C_9$ free from iron and other foreign elements. The fiber is physically recognized as pure white #1 quality insulating fiber, length ¾" - 1" or #2 grade length 3/8" - 5/8". The method of grading employed by the asbestos mill comprises a screen test which is described briefly as follows: A 16 oz. sample of asbestos fiber is successively screened using first, two mesh screen, then four mesh and ten mesh. The bottom is a solid pan which retains "shorts" or fine splinters of unopened fiber. A typical screen analysis of #1 fiber and #2 fiber is given below:-

Method of grading

#1 Fiber 16 oz. sample

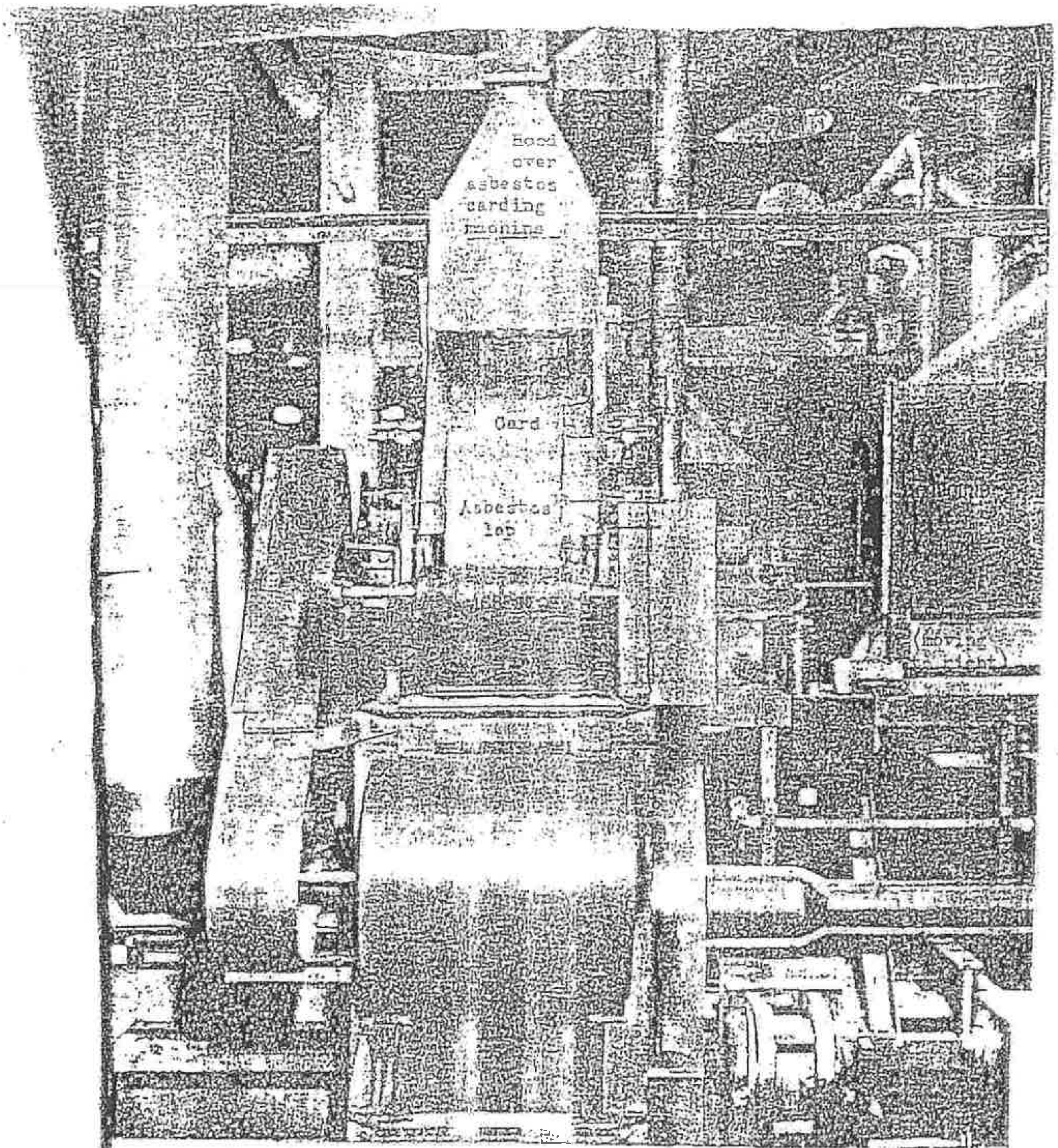
First screen	2 mesh	15.376 oz.	96% retained
Second "	4 "	.354 "	"
Third "	10 "	.240 "	"
Bottom - Solid pan		.030 "	0.18% shorts

#2 Fiber

First	15.085 oz.	94% retained
Second	.640 "	"
Third	.195 "	"
Bottom	.082 "	½% shorts

Asbestos Textiles for Insulations

The above grading represents a final control test of quality of fiber used in the manufacture of asbestos textiles, such as roving, yarn



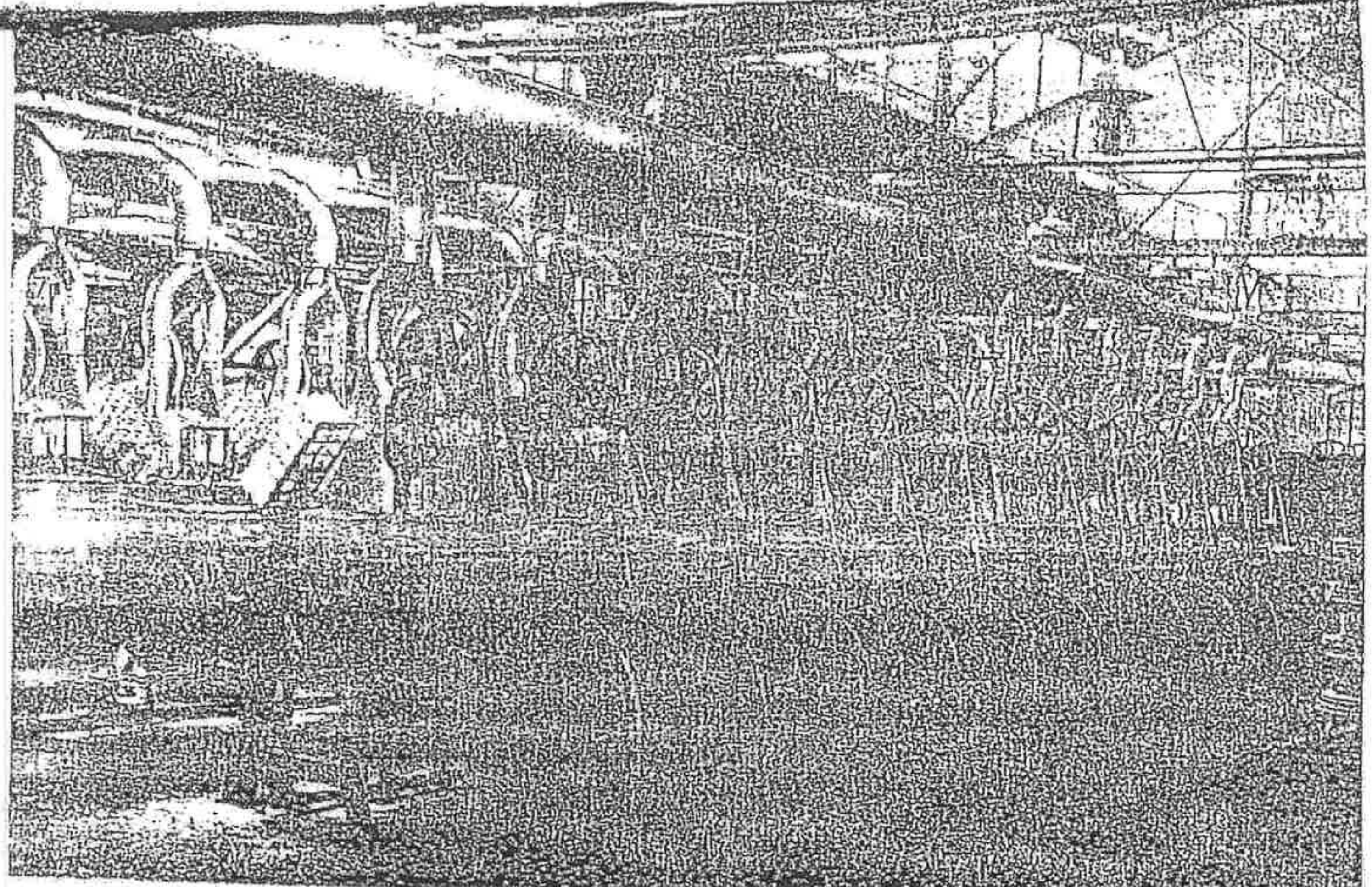
[illegible] York Wire Works (G.E.Co.) is shown a [illegible]-Machine. About 50-50 amounts of [illegible]stos and compound are placed upon the wire by this machine. The asbestos is [illegible] and placed upon the wire [illegible] felt. The asbestos dust and waste from this [illegible] are removed by the hood shown. This type of wire is used in electric [illegible], motor leads and fluorescent light fixtures. The steps are (1) asbestos [illegible] on wire, (2) run through [illegible] compound, and (3) "polish out" excess [illegible]ound. The movement of wire through this machine is from left to right.

and lap designed for use in insulated wire manufacture. The fact may now be recognized that the quality and grade of product supplied by the asbestos mill for wire insulating purposes is already highly refined. The crushing, grading and refining has been completed leaving the product which the wire manufacturers must handle free from dust particles. The problem therefore becomes one of controlling the fly of short asbestos fibers. If permitted to fly in the work room, the fibers adhere to practically all rough surfaces and projections, settle on operating equipment, floors, beams, etc. and cause in a short time an unsightly appearance. The abrasive action of the asbestos on rotating members, bearings, gears, cams, is also extremely violent necessitating costly replacements and repairs or high maintenance costs. The installation of adequate ventilating equipment and control measures at York has effectively eliminated these conditions as well as any semblance of health hazard.

The process of manufacturing asbestos insulated wire at the General Electric Company, York Works, requires the utilization of asbestos fiber in the form of lap or rolls, (Sample for illustration). The material received from the asbestos mill in this form is re-carded and fed to the wire element in the required quantity to produce the desired insulation thickness.

See 1.

The process of re-carding the asbestos fiber and transferring same to the wire element generates asbestos dust and fly, which is controlled by proper exhaust equipment. The simplest, most effective and lowest cost method which we have devised, without interfering with production, incorporates a hood completely enclosing the generating unit utilizing hinged doors with shatter proof glass windows for operating control. The volume of air handled is a function of hood opening and velocity, the latter being



At the York Wire Works of the General Electric Company, is shown the asbestos braiding operation. Here all types of wire are braided with asbestos yarn. Bobbins of asbestos (called packages) are observed at the left and [illegible]. Asbestos is used on wire for Class-B insulation (125 deg. C) for example; boiler rooms, switch boards, elevators, cranes, battleships, etc.

The by-product asbestos dust, or waste, is efficiently removed by the illustrated ventilation system and piped to a dust collector, outside the building.

dependent upon particle size, specific gravity turbulence and location of hood opening for most effective control.

C.F.M. = Area (Sq. Ft.) X V (F.P.M.)

Referring to figure #1 - Slide No. 1 pictured is a typical hood used in the process completely enclosing the generating unit. The hood opening measures 1' x 3' x 1' making an overall area of 3 sq. ft. The velocity used at hood opening is 300 ft/ min. or a volume of air handled of 900 C.F.M.

The single branch pipe velocity at entrance to hood is 2000 ft/ min. A blast gate and by pass damper are also provided for reducing velocities if desired.

Figure (2) illustrates the method of fiber collection and system of removing the collected fibers. The equipment comprises a Pangborn Cloth Screen Dust Collector, arranged for outside location and selective operation. There are 124 screens covered with cotton filter fabric arranged side spaced 5½" centers providing an active area of 5150 sq. ft. These are equipped with motor driven screen vibrating mechanism utilizing 4 1800 RPM motors.

The collector is provided with a central partition through the collector screen section and dust box shown below to permit continuous operation. Under normal operations, air flows to both sides of the collector. Provisions have been made permitting the entire air flow to be diverted to the collector in order to vibrate screens in the other half and clean the dust box section below the isolated screen section. The air flow gates are then reversed to permit screen vibration and cleaning of the opposite half of the collector. The air flow gates are finally opened so as to return both screens sections to the line. This operating cycle is performed once each day as a result of our experience. The removal of

asbestos fibers from the dust box section is accomplished manually through four unloading thimbles in the bottom of dust box. Large collector bags positioned with bag clamps receive the asbestos fiber (See photo.) The dust velocity maintained throughout the main duct system is 4000 ft/ min.

The system is operated by a single exhauster, backward curved blade type, designed to handle 16,420 C.F.M. from 70, 4" diameter exhaust connectors. A 10% leakage allowance brings the total C.F.M. to 18,120, at 1629 R.P.M. A 40 HP - 1800 RPM motor is used to operate the exhauster. This installation has now been in operation approximately three years continuous service and has proven its value through results secured in improved housekeeping, working conditions and good health insurance. The waste asbestos fiber formerly thrown away has been reduced by 20%. In other words, we have added to our saleable waste 20% of good fiber which is valued at $500. per year.

Health Routine

The procedure which constitutes a complete program of health routine at the York Works, I feel is of tremendous importance and if time permitted would justify more detail regarding the administration of each precautionary measure. In brief, this program to protect the health and safety of employees develops the following practices:

1. A thorough physical examination and pre-employment history a pre-requisite to initial employment.
2. A distribution of G. E. Co. Booklets on general safety requirements requiring employees signatures.
3. A distribution of booklets on rules and precautions of safety and health applying specifically to the York Works.
4. Distribution and furnishing of following materials:
   (a) Clothing - Coveralls - Underwear - caps - gloves.
   (b) Towels - Soap - Protective Cream

EXHIBIT G

See page 3

NO. 90-23333

	§	IN THE DISTRICT COURT OF
	§	
IN RE: ASBESTOS CASES	§	HARRIS COUNTY, T E X A S
	§	
	§	MASTER ASBESTOS FILE

DEFENDANT WESTINGHOUSE ELECTRIC CORPORATION'S
ANSWERS AND OBJECTIONS TO PLAINTIFFS'
INTERROGATORIES AND REQUEST FOR PRODUCTION TO DEFENDANTS

Defendant, Westinghouse Electric Corporation ("Westinghouse") hereby responds to Plaintiffs' Interrogatories and Request for Production to Defendants as follows:

PRELIMINARY STATEMENT AND GENERAL OBJECTION

The information sought in these interrogatories and requests for production has been provided to plaintiffs many times previously. Some of these matters have been the subject of numerous depositions. Also, plaintiffs' counsel have reviewed hundreds of thousands of pages of Westinghouse documents previously produced, as evidenced by the inclusion of Westinghouse documents in plaintiffs' Master Exhibit List. Therefore, Westinghouse objects to these discovery requests as redundant, overly broad, and intended only to harass and waste the resources of Westinghouse. Westinghouse respects the fact that these discovery requests are in a form which has been used in asbestos cases against defendants whose primary business was the manufacture of asbestos thermal insulation. For the reasons set forth below, Westinghouse respectfully submits that this discovery, as applied to Westinghouse, is unduly burdensome and would require Westinghouse to invest massive financial and manpower resources which far outweigh the likelihood that this effort would lead to the discovery of admissible evidence. Westinghouse

f. a full and precise description of the package in which the asbestos fiber was sold, including, but not limited to, type of package, size, color(s), and writing thereon;

g. all names under which the asbestos fiber was sold;

h. the identity of all records reflecting the sale or transfer of said asbestos fiber;

i. the identity of the present custodian of photographs of the burlap bags in which the asbestos fibers was stored and/or shipped;

j. the address of each sales office and sales region for the sale of the asbestos fiber;

k. the name of each authorized distributor of the asbestos fiber produced;

l. the identity of each owner and operator of the mine prior to the date you first began operation of the mine, and the dates thereof, and

m. the identity of each owner and operator of the mine subsequent to your ceasing operation of the mine.

RESPONSE: See Preliminary Statement and General Objection. Westinghouse objects to this Interrogatory as it is overly broad and unduly burdensome and seeks information which is irrelevant and immaterial to these proceedings and which is not reasonably calculated to lead to the discovery of relevant, material or admissible evidence. Subject to and without waiving these and the foregoing General Objection, Westinghouse is not now and never has been a member of the asbestos mining and bulk insulation industry (commonly referred to as the "asbestos industry"). Westinghouse has never mined or milled asbestos ore or sold raw asbestos products. Further, neither present nor former subsidiaries of Westinghouse have ever been a miner or miller of asbestos fibers.

8. Is answering defendant aware of the possible connection between exposure to asbestos or asbestos products and:

a. Asbestosis?

b. Lung cancer, all cell types?

c. Mesothelioma?

d. Colon cancer?

e. Stomach cancer?

f. Laryngeal cancer?

g. Cancer of the kidney?

h. Cancer of the Esophagus?

i. Other gastrointestinal cancers?

j. Pneumoconiosis?

RESPONSE: See Preliminary Statement and General Objection. Westinghouse objects to this Interrogatory because of the argumentative, categorical manner in which it is phrased. In the instant cases Westinghouse has not been adequately informed to offer any opinions as to causal relationships, if any, between various substances and any diseases that the plaintiffs allegedly have. Provided it were offered specific product identification and specific locations and durations of exposure to asbestos-containing products allegedly manufactured by Westinghouse, Westinghouse would defer to the reasoned judgment and opinions of its medical expert witnesses on all such questions of human diseases, their causes, and diagnoses. Subject to and without waiving this and the foregoing General Objection, Westinghouse responds as follows:

Westinghouse has not learned that mere exposure to asbestos, without more, constitutes a health hazard. Westinghouse generally has learned that inhalation of certain types and quantities of asbestos fibers over certain periods of time is associated with increased risk of health hazards for some people.

9. If your answer to the above interrogatory, as to any or all of its sub-parts, is affirmative, identify:

a. When and how defendant first learned of such connections;

b. If knowledge was obtained by attendance at any conference, lecture, convention, symposium or meeting, identify such meeting and provide the identity of person attending or documents obtained;

c. If knowledge was obtained from medical or scientific studies, or any other published work, identify same;

d. If otherwise obtained, identify manner of receipt of document or communication.

RESPONSE: See Preliminary Statement and General Objection. Westinghouse was a member of the American Hygiene Foundation (AHF) and has learned that AHF distributed abstracts which summarized articles dealing with industrial hazards including asbestos in the mid-1930's. Westinghouse learned that inhalation of certain types and quantities of asbestos fibers, over significant periods of time, was being associated with increased risks of disease for some people

by the early 1940's. The specifics of exactly how or when Westinghouse personnel acquired such knowledge or awareness is not reasonably known or ascertainable, but it is probable that it came from reading government publications or other public documents, reports, studies or journals, including industrial hygiene and medical journals. Westinghouse obtained this level of knowledge based upon what was published at that time, all of which was based on the relevant work histories, dose, fiber type, length of exposure and other variables of the particular study, periodical or journal.

10. With regard to any knowledge obtained subsequent to that identified in the above interrogatory, and up until the time that you ceased to sell and/or manufacture asbestos products, identify:

a. All documents or other communications, oral or written, concerning the casual connection between exposure to asbestos or asbestos products and disease, and identify of persons so communicating;

b. Did answering defendant obtain from or transmit any such information to other defendants in this case? If so, identify:

1. manner of receipt or communication for each contact;

2. all documents and persons involved.

RESPONSE: See Preliminary Statement and General Objection. See Responses to Interrogatories Nos. 8 and 9. Westinghouse maintains general reference materials and technical libraries throughout the corporation, which may include various industry periodicals, occupational health and medicine periodicals and other topical reference materials. There is no central indexing system that contains all of the information requested by this Interrogatory for all departments within the corporation. Thus, Westinghouse objects to this Interrogatory on the grounds that it is unduly broad and burdensome, and that it seeks information which is not reasonably calculated to lead to the discovery of material or admissible evidence.

11. As to any knowledge possessed by answering defendant at any time referred to in answers to the preceding three interrogatories did you educate your employees, distributors, or purchasers about the hazards known to you and any safety precautions necessary to guard against cancer and other diseases arising from the use and handling of your asbestos containing products? If so, identify:

a. When and in what manner customers, insulators, non-employee factory workers and the general public were so informed;

b. Documents communicating or otherwise disseminating such information;

c. Programs initiated or sponsored to establish or promote safety procedures, methods or usage of asbestos containing products;

d. Published articles or reports by employees (present or prior), including those of medical directors, scientists, engineers or other professionals;

e. Symposia or lectures sponsored for the benefit of asbestos workers and/or the general public.

RESPONSE: See Preliminary Statement and General Objection. Westinghouse objects to responding to this Interrogatory as to products not alleged to have contributed to the injuries of the plaintiffs.

Subject to and without waiving these and the foregoing General Objection, see Response to Interrogatory No. 5. Westinghouse further states that it supplied its employees with cautions or instructions regarding the use of asbestos. The cautions or instructions were located on one or more of the following internal documents: Material Cards, Process Specification forms, or Safe Practice Data Sheets. Hundreds of pages of these materials have been previously produced and such documents have been the subject of depositions of former and current Westinghouse employees.

A Material Card is an internal document which controls a material or a part which is purchased by brand name, trade name, catalogue number or other standard. Process Specification forms are internal documents which outline the required procedures for given manufacturing processes. Safe Practice Data Sheets were a means of communicating cautions and instructions at the plant level.

The first Safe Practice Data Sheet containing information about asbestos was written in 1953. The earliest date a caution or instruction would have appeared on a Material Card was probably in the mid to late 1950's. The same is true of cautions or instructions on Process Specification forms.

Westinghouse also believes that it provided some distributors and/or purchasers, with Westinghouse Material Cards and Process Specification Forms containing cautions or instructions regarding the use of asbestos. Given the size and scope of the company's operations, it is not reasonably possible to determine the specifics of how and when such materials were provided to specific purchasers, but it was routinely provided upon the request of a pruchaser for the kind of information found in Material Cards and/or process specs.

CERTIFICATE OF SERVICE

This is to certify that a true and correct copy of the foregoing Defendant Westinghouse Electric Corporation's Answers to Plaintiffs' Master Interrogatories and Requests for Production has been forwarded to counsel for Plaintiffs via certified mail return receipt requested and to all other known counsel of record via U.S. Mail, regular delivery, on this the 24th day of June, 1992.

Mark A. Hendrix
ATTORNEYS FOR DEFENDANTS

RIE:7342
U:\W-TX\INTEROG.ANS
June 16, 1992
10:36am

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

Before me, the undersigned authority, a Notary Public in and for said Commonwealth and County, personally appeared Daniel D. Vickovic, who, being duly sworn, deposes and says that he is ASSISTANT SECRETARY OF WESTINGHOUSE ELECTRIC CORPORATION, and that he signs the foregoing WESTINGHOUSE ELECTRIC CORPORATION'S ANSWERS TO PLAINTIFFS' MASTER INTERROGATORIES AND REQUESTS FOR PRODUCTION on behalf of that defendant and is duly authorized so to do; that the matters stated in the foregoing document are not necessarily within the personal knowledge of deponent and that deponent is informed that there is no officer of WESTINGHOUSE ELECTRIC CORPORATION who has personal knowledge of all such matters; and that the facts stated in the foregoing document have been assembled by authorized employees and counsel of defendant and deponent is informed by those authorized employees that the facts stated in the foregoing document are true.

Daniel D. Vickovic
Assistant Secretary

SWORN TO and subscribed
before me this 18th day
of June, 1992.

JoAnn Young
Notary

Notarial Seal
Jo Ann Young, Notary Public
Pittsburgh, Allegheny County
My Commission Expires Aug. 2, 1993
Member, Pennsylvania Association of Notaries

EXHIBIT H

STATE OF PENNSYLVANIA §

COUNTY OF PHILADELPHIA §

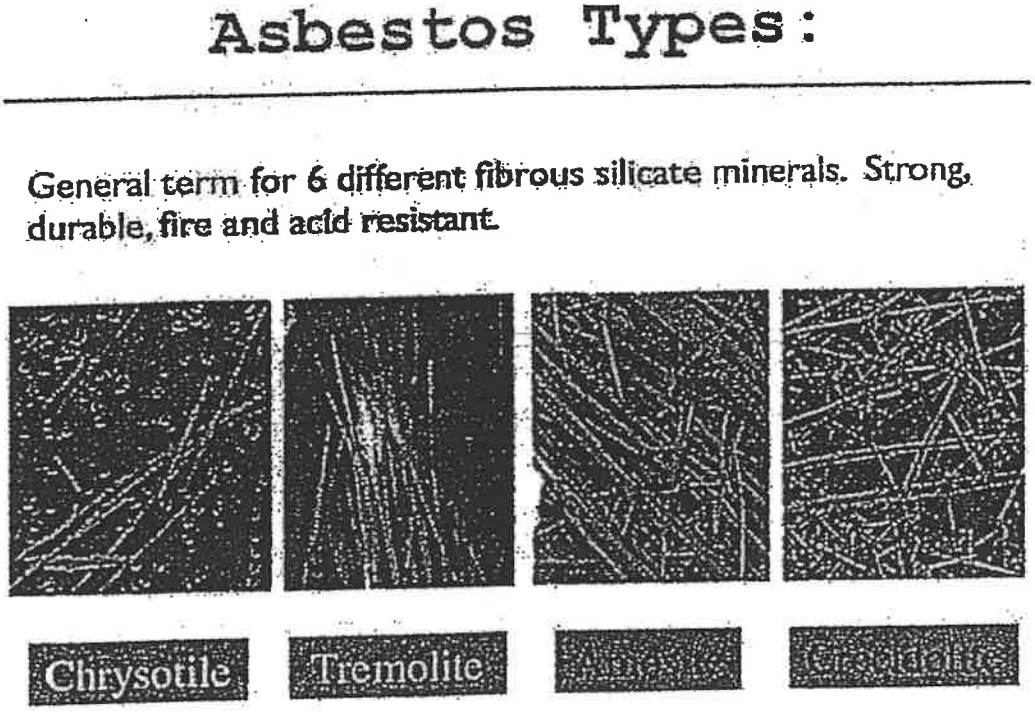
AFFIDAVIT OF ARTHUR L. FRANK, M.D., Ph.D.

I am a Physician and Professor of Public Health at Drexel University where I hold the position of Chair Emeritus of Environmental & Occupational Health. I am also a Professor of Medicine at the Drexel University College of Medicine. I am also a Professor of Civil, Architectural and Environmental Engineering. I hold various adjunct professorships at various other universities. I am a Board Certified medical doctor, having received my medical degree in 1972, from the Mt. Sinai School of Medicine. I have been Board Certified by the National Board of Medical Examiners since 1973; have been a Diplomat of the American Board of Internal Medicine since 1978 and with the American Board of Preventive Medicine (Occupational Medicine) since 1979. I received my Ph.D. in 1977 from the City University of New York, where I studied in its Biomedical Sciences Doctoral Program. I have performed cancer research at the National Cancer Institute, participated in epidemiologic studies of asbestos-exposed populations, taught asbestos medicine and public health to medical students and doctors, and have devoted much of my professional life to the study and prevention of asbestos-related disease. I have published numerous peer-reviewed papers, book chapters and presentations on the topic of the causes and prevention of asbestos-related disease. In 2016, I received the Ramazzini Award from the Collegium Ramazzini for my "distinguished record of occupational health and safety research as well as his advocacy and service in the promotion of better occupational safety and health in developing countries and in the international fight to ban the use of asbestos." My current CV is available upon request. The opinions herein are based on my own work, experiences, publications and those cited. I have provided expert opinion in numerous jurisdictions, mostly for plaintiffs, on the causation between asbestos exposure and the development of mesothelioma and other asbestos-related diseases. While my employers have traditionally charged for much of my professional time working on such matters, I personally have not received any direct compensation for my medical-legal consulting. I have, however, used some of the revenue generated to support my university departments. I have not charged for any of the work on this affidavit.

II. Information About the Hazards of Asbestos was Available from the Early Twentieth Century.

30. I have authored a textbook chapter entitled *The History of Extraction and Uses of Asbestos* in Dodson & Hammar, *Asbestos: risk assessment, epidemiology, and health effects*, CRC Boca Raton (1st Ed. 2006). Much of this section is taken directly from that chapter.

31. Asbestos is a commercial term used to describe two families of naturally occurring minerals. Amphiboles, containing five fiber types, and the serpentine variety, chrysotile, were materials known to the ancients. The following accurately depicts the appearance of the four types of asbestos most commonly found in products:



32. While these different types of asbestos have different elemental makeup, they all cause asbestos-related diseases. Claims by industry-aligned scientists that chrysotile is a less potent carcinogen due to its relative lack of iron content, are unsupported. As Stayner et al. (1996) explained,

> comparison of the carcinogenic potencies of fibers in the rat in vivo does not support the hypothesis that carcinogenic potency is related to iron content. As discussed above, Wagner et al. observed similar numbers of tumors in rats with crocidolite, amosite, and chrysotile, even though these fibers have an elemental iron content of 40%, 28% and less than 1%, respectively. The

> nonasbestos mineral erionite does not include iron as a constituent but is nonetheless a potent mesothelioma inducer in rats.[63] . . .
>
> Therefore, no obvious correlation between iron content and carcinogenicity is apparent in the rat.[64]

Erionite is also recognized as a potent cause of mesothelioma in humans, despite its lack of iron.

33. More than 4,000 years ago, pottery in Africa and Finland contained asbestos, and Finnish homes were known to contain asbestos rock to pack crevices in log huts. The lamps of the Vestal Virgins in ancient Rome had wicks made from asbestos so the lamps would burn continuously, as long as they were filled with oil. Various Roman historians noted slaves working in asbestos mines were not as healthy as others, and were thought to die young.[65]

34. Charlemagne, Emperor of the Holy Roman Empire, was said to have possessed a tablecloth woven of asbestos, and would astonish his guests by cleaning his tablecloth in a roaring fire.[66] Additional history of the early use of asbestos can be found in the paper by Abratt et al.[67]

35. By 1850, chrysotile deposits were known around Thetford, in Canada. These deposits were again appreciated following a forest fire when in the mid-1870s outcroppings of rocks were noted to not have burned. By 1876, some 50 tons of asbestos was being mined in Quebec and brought to market through a specially built railroad. By the 1950s, over 900,000 tons per year were being mined with a value of almost 100 million dollars.[68]

36. In the early 1800s, asbestos was identified in South Africa,[69] particularly in the northwest area of Cape Province, where the name crocidolite was given to a blue-colored stone otherwise known as "wooly stone." Further interest did not occur until the 1880s and the first records of serious production did not take place until early in the twentieth century. The amount of asbestos produced was far less than from Canada, remaining below

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[63] Stayner et al., *Occupational Exposure to Chrysotile Asbestos and Cancer Risk: A Review of the Amphibole Hypothesis,* Am. J. Public Health 86(2) (1996).
[64] Stayner et al., *Occupational Exposure to Chrysotile Asbestos and Cancer Risk: A Review of the Amphibole Hypothesis,* Am. J. Public Health 86(2) (1996).
[65] Selikoff, Irving J., and D.H.K. Lee. Asbestos and Disease. (Academic Press, New York 1978).
[66] Stayner et al., *The Worldwide Pandemic of Asbestos-Related Diseases*. Annual Rev. Public Health, 34: 4.1 – 4.12 (2013).
[67] Abratt et al., *Asbestos and Mesothelioma in South Africa.* Lung Cancer. 45:S3-S6 (Supp.) (2004).
[68] Stayner et al., *The Worldwide Pandemic of Asbestos-Related Diseases*. Annual Rev. Public Health, 34: 4.1 – 4.12 (2013).
[69] Selikoff, Irving J., and D.H.K. Lee. Asbestos and Disease. (Academic Press, New York 1978).

10,000 tons per year until 1940. In the Transvaal of South Africa a different form of asbestos was mined and was called amosite, an acronym for the Asbestos Mines of South Africa. By 1970, some 80,000 tons per year of amosite was being produced. The mines from which the majority of amosite was derived were run by a small number of Europeans with 6,500 local workers of color.

37. Other locations with significant production of asbestos included Italy, Russia, the United States, Brazil, Rhodesia (now Zimbabwe), and more recently, China. Italy was never a major producer of asbestos, not being able to compete with the larger quantities available in Canada. Russian production was substantial, rivaling that produced in Canada. Russian mines produce primarily chrysotile. In the United States, deposits were mined in Vermont, Arizona, and California. Smaller deposits of anthophyllite were mined in North Carolina and Georgia. In Zimbabwe, mines became operative early in the twentieth century and reached a peak production of 95,000 tons.

38. China has become a major producer and rivals Russia in terms of asbestos production. In 2000, Russia led the world with 700,000 tons, followed by 450,000 tons from China and 335,000 tons from Canada. Canada recently halted production of asbestos. In 2000, the United States was producing only some 7,000 tons from mines in California and elsewhere, this out of a worldwide production of 2,130,000 tons.[70] Not surprisingly, Russia and China accounted for most consumption of asbestos followed by Brazil, India, Thailand, and Japan. The United States used about 15,000 tons of asbestos in 2000, down from a peak of 803,000 tons per year in the early 1970s. At the present time, the United States imports less than 2,000 tons.

[70] Tossavainen, *Global Use of Asbestos and the Incidence of Mesothelioma.* Int. J. Occup. Environ. Health. 10:22 (2004).

39. On a per capita basis, as of about 2014, the greatest use of asbestos is in Russia and former Soviet Republic countries, and in Thailand. Among the countries with lowest per capita usage, other than in countries that have now banned asbestos, are Canada, the United States, and several others at one tenth of a kilogram per capita per year. Although on a per capita basis India ranks low, it stands second in the world's total usage. China, while first in the world, also has a relatively low per capita amount, given its large population base. Major use in the United States is for asbestos cement and roofing materials. In much of the rest of the world asbestos containing cement, construction materials, friction products, and textiles are made, used, and exported. The following figure, reproduced from Frank and Joshi, *The Global Spread of Asbestos*, Ann. Global Health 80(4): 257 - 62 (2014), summarized recent data on the use of asbestos:

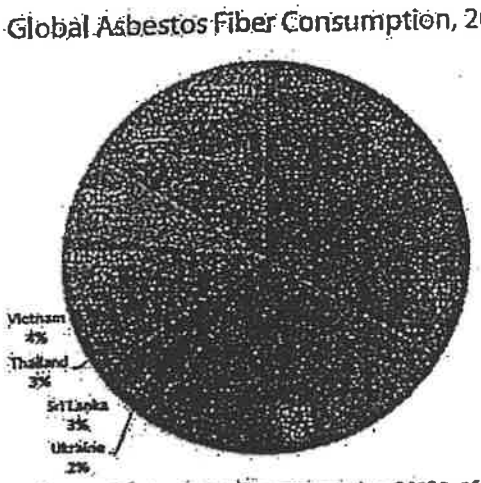

Figure 4. Global asbestos fiber consumption, 2012*. *Source: International Ban Asbestos Secretariat & Citi Research.

Commercial Uses of Asbestos

40. Although there has long been historical use of asbestos, it was originally more a curiosity than a meaningful commercial material. This changed in the last half of the nineteenth century as asbestos began to be used in many commercial settings. For example, with industrialization and the use of steam to drive equipment, it was recognized that asbestos could serve a useful purpose as insulation material.

41. It became increasingly apparent that asbestos, because of its various properties, was extremely useful in many situations. Asbestos resists degradation under heat and cold, does not conduct electricity, and is extremely chemically resistant, including having resistance to many industrial acids. Because of its heat, cold and chemical resistance, asbestos was used in many products. Different types of asbestos were found especially useful for different purposes.

42. In the nineteenth century, the first systematic use of asbestos was for sealing and packing materials, soon followed by its use in the insulation for heat conservation. The

manufacture of asbestos roofing felt and cement came soon thereafter, as did the development of textile made from asbestos.[71]

43. Around the turn of the century asbestos containing cement pipe was produced. The asbestos allowed for added strength, creating lighter and thinner cement materials. The first use of asbestos as a brake lining occurred in 1906, and clutch facings were developed in 1918. In Great Britain, a technique for spraying asbestos as a fireproofing material was developed in the early 1930s, and this technique was imported into the United States a few years later. Considerable use of asbestos was noted during the shipbuilding era in and around World War II. For the first time millions of people, including many women, were exposed to asbestos.

44. After World War II, asbestos was used as a material in plastics, in building materials such as joint compound, spackling, plaster, paint, asphalt, acoustic material, reinforcement for cement siding, and many other new uses. Asbestos was used for filtering wine, beer, and pharmaceutical products. Crocidolite asbestos was even used as a component of one brand of cigarette filters between 1952 and 1956.

45. Asbestos found its way into plasters and stuccos, was used in drilling mud for oil wells and other similar operations, and was used in automobile body under-coatings. Yarns made from asbestos were used in a wide variety of ways, including rope, sewing threads, gas mask filters, wire covering, and for steam hoses, among others. Cloth made from asbestos was incorporated into blankets, mailbags, theater curtains and commercial products such as ironing board covers. Other consumer products, including hair dryers, bowling balls, toasters, play sand, and baby and adult talcum powders were shown to contain asbestos.

46. Construction materials containing asbestos included millboards, cements, laboratory table tops, electrical pump insulation and mountings, and flooring. This listing of products is by no means comprehensive - asbestos was used in 3,000-4,000 commercial products.

47. Increasingly, the use of asbestos is being banned around the world. Even Canada has now effectively closed the Quebec asbestos mines. The current use of asbestos includes building supplies, such as roofing materials and asbestos cement pipes. Automobile brake components continue to contain asbestos, and asbestos cloth is still used in firefighting protective gear. For some countries, the continued sale of asbestos is a significant economic issue. This is in the face of irrefutable evidence of the health hazards of all forms of asbestos, and continuing evidence, especially in developing countries, of no real "controlled use" of asbestos, including chrysotile.

48. With the ban of the use of asbestos in Japan, only developing countries continue to use large quantities of asbestos. China and India, for example, continue to mine and use asbestos, the most frequent use being in construction materials. Thailand, another

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[71] Stayner et al., *The Worldwide Pandemic of Asbestos-Related Diseases*. Annual Rev. Public Health, 34: 4.1 – 4.12 (2013).

growing economic power in Southeast Asia, continues to use large quantities of asbestos as well. Encouragement for the use of asbestos in such countries comes from the West, where the hazards are increasingly well recognized and actions are being taken internally to reduce or eliminate the use of asbestos containing products.

Public Health Issues and the Uses of Asbestos

49. The world has a long history of asbestos use, with some suggestions of potential health hazards by the ancients. The real history appreciating the hazards of asbestos begins in the late 1890s.

50. The term pneumoconiosis, having been coined by Zenker[72] in 1867 after examining the lungs and pleura of a man with siderosis, was applied to an increasing number of dust diseases of the lung. In 1924, Cooke coined the term asbestosis.[73]

51. Morris Greenberg, who served as a medical member of the Inspectorate of Factories in Great Britain and is a scholar of the historical aspects of asbestos-related disease, wrote excellent historical overviews of the development of knowledge regarding the hazards of asbestos and the development of mesothelioma.[74] These articles provide an excellent historical account of one aspect of the development of knowledge about the hazards of asbestos and the failings of some in the medical community.

52. In Great Britain, as early as 1898, the Lady Inspector of Factories made note of the fact that asbestos was causing disease among asbestos textile workers.[75] In 1899, Dr. H.M. Murray conducted a post-mortem examination on a young man in his mid-thirties who died of respiratory insufficiency. Dr. Murray reported, during the patient's hospitalization, that the patient was the tenth individual in his particular work area to die, and that his working brethren had all preceded him in death at a young age from similar problems. Dr. Murray noted the man had extensive interstitial fibrosis, and what was described as "curious bodies" in his lungs. In 1907, the autopsy findings, with commentary, were published and optimistically concluded that proper ventilation was now thought to be in place to spare additional workers disease in the future.[76] Unfortunately this was far from correct.

53. In 1915 Collis, after giving a series of lectures, wrote up his findings on pneumoconiosis and discussed the problems of silicosis and asbestos-induced fibrosis, not yet called

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[72] Zenker, *Iron Lung-Siderosis Pulmonous*. Dtsc. Arch. Klin. Med. 2:116 (1867).
[73] Stayner et al., *The Worldwide Pandemic of Asbestos-Related Diseases*. Annual Rev. Public Health, 34: 4.1 – 4.12 (2013).
[74] Greenberg et al., *The Doctors and the Dockers*. Am. J. Ind. Med. 45:573 (2004); Greenberg et al., *Mesothelioma Register 1967-68*. Br. J. Ind. Med. 31:91 (1974).
[75] Annual Report of the Chief Inspector of Factories and Workshops for the Year 1898, Her Majesty's Stationery Office, p. 171 (1898).
[76] Murray, H.M. Departmental Committee on Compensation for Industrial Disease, Minutes of Evidence, Appendices and Index, p. 127 (Wyman and Sons, London, 1907).

"asbestosis."[77] The term asbestosis was not used until 1924, when Cooke coined the term to describe pulmonary fibrosis due to the inhalation of asbestos dust.[78] By 1930, Merewether and Price wrote of the principles to protect workers in England,[79] and Lanza in the United States showed that suggested levels of asbestos in the late 1930s were often too high to protect workers.[80]

54. Although previously unnamed, the disease entities caused by exposure to asbestos were not unappreciated. In 1918, a vice president of the Prudential Life Insurance Company, who was a statistician, informed the company there was harm in breathing asbestos dust. At this point in time, Prudential ceased issuing policies on the lives of asbestos workers in the United States and Canada.

55. Although not reported in the scientific literature until many decades later by Tweedale, relatively recent revelations written up revealed at least one major asbestos company in England knew, beginning in the 1920s that its workers were dying of lung cancer and mesothelioma. This company worked diligently to suppress this information.[81]

56. Since 1930, and probably earlier, asbestos dust had been recognized as a hazard wherever visible dust could be seen. In 1930, Merewether and Price stated that "[i]f there is visible asbestos dust, then the invisible dust is in dangerous concentration."[82] In 1935, another insurance company engineer published that "[i]f you can see the dust, you know it to be a terrific hazard."[83]

57. Beginning in 1946, the American Conference of Governmental Industrial Hygienists ("ACGIH") began publishing a list of Maximum Allowable Concentrations ("MAC") and later published Threshold Limit Values ("TLV") for various harmful substances, including asbestos. The first MAC for asbestos was set "without any review of research or data" and the committee wrote that the values were "not to be construed as recommended safe concentrations."[84] This TLV level, designed only to reduce

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[77] Collis et al. *The Pneumoconiosis*. Publ. Health. 28:252-264 (1915).
[78] Cooke, *Fibrosis of the Lungs Due to the Inhalation of Asbestos Dust*. Br. Med. J. 2, p. 147 (July 26, 1924).
[79] Merewether et al., *Report on the Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry*. Her Majesty's Stationery Office (1930).
[80] Lanza, *Silicosis and Asbestosis*, Etiology, Symptoms, Diagnosis Oxford University Press, page 59 (1938).
[81] Tweedale, From Magic Mineral to Killer Dust: Turner and Newall and the Asbestos Hazard. Oxford University Press (Oxford, 2000).
[82] Merewether et al., *Report on the Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry*. Her Majesty's Stationery Office (1930).
[83] Johnson, *No Halfway Measures in Dust Control*, National Safety News, (Sept. 1935) (noting a difference between pure silica and asbestos dust but observing "[i]f you can see the dust, you know it to be a terrific hazard.").
[84] Egilman et al., *The origin and development of the asbestos Threshold Limit Value: scientific indifference and corporate influence*, Int. J. Health Serv., 25(4) :667-96 (1995).

asbestosis, was "known to be inadequate when first proposed, was severely criticized between 1946 and 1968, but nonetheless was promulgated annually and remained unchanged until 1971."[85]

58. The protective measures necessary to prevent asbestos disease are the same for asbestosis, lung cancer, mesothelioma or other malignancies. A company that protected its workforce, their families, and bystander co-workers against any asbestos-induced disease would have reduced the risk to its work force from all asbestos-induced diseases. Indeed, if the company used the most basic protective measure – eliminating the use of asbestos in favor of a safer substance – the risk to both the worker and all others could have been eliminated entirely.

59. Since the beginning of the twentieth century, the protective measures a company could take to protect its workforce from exposures to toxic dust have included:

- Warning workers of dangerous health effects and how to avoid harm,
- Instructing workers on hazardous substances and giving out warning literature,
- Repeating instructions frequently,
- Posting warnings and providing constant supervision of working conditions,
- Using proper ventilation and housekeeping,
- Controlling dust at the place of origin to prevent inhalation and ingestion,
- Substituting safer materials for more hazardous materials and/or processes,
- Requiring showers and separate lockers for non-work and work clothing, and frequent cleaning of clothing,
- Routine, periodic medical examination of the workers and notification of findings, and
- Use of respirators, as necessary.

These protective measures have been well known for at least 100 years and continue today to be the backbone of workplace safety when dealing with dangerous substances and processes in the workplace. Moreover, these measures are the same whether the substance at issue is lead, silica, asbestos, cotton or any pneumoconiosis or cancer producing dust.

60. If implemented, these measures would protect the worker, bystander and other workers on the jobsite, and the workers' spouses and children from exposure to toxic substances that might be brought home on workers' clothes. It was reasonably foreseeable this could occur from at least 1930, and probably before.

61. It was for this reason – to give workers the knowledge of the need to protect themselves and their families – that Merewether and Price recommended the workers be given a "sane appreciation of the risk" of working with asbestos.[86]

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[85] Egilman et al., *The origin and development of the asbestos Threshold Limit Value: scientific indifference and corporate influence*, Int. J. Health Serv., 25(4) :667-96 (1995).

Twelve (AB)

62. Thirteen years before Merewether and Price wrote about the hazards of asbestos, Alice Hamilton, a pioneer of industrial hygiene and occupational medicine, made clear it is the job of the industrial physician to prevent occupational disease. She also observed and reported that factories very well may be poisoning neighborhoods: In a factory using "litharge and red lead" that was covered "with layers of these poisonous dusts," Hamilton described the plant manager, disappointed about her lack of excitement about the facilities:

> One of them finally brightened up, and said "Come and see this." I saw a wonderful air-washing machine, very expensive. He said "Every cubic foot of air is washed before it comes in." I felt like saying, *"You had better wash it before it goes out, or it will poison the neighborhood."*[87]

As noted above, from the standpoint of the occupational medicine physician, the need for controls to prevent the spread of disease outside the factory from dangerous materials used inside the factory was well recognized and not confined to a particular substance.

63. For example, in 1942, General Electric Co. and the State of Pennsylvania discussed methods to prevent spreading workplace poisons beyond the workplace including shower baths, and separate street clothing and work clothing in a factory that used asbestos felt to insulate wire.[88]

64. By 1953, the Walsh-Healy Act similarly required showers, separate lockers for street clothes and work clothes, and other protections to prevent asbestos from leaving the jobsite and poisoning family members.

65. The first published suggestion of the relationship of asbestos exposure and lung cancer was by Drs. Lynch and Smith, making observations of workers at a South Carolina

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[86] Merewether et al., *Report on the Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry.* His Majesty's Stationery Office (1930).

[87] Hamilton, *The Fight Against Industrial Diseases – The Opportunities and Duties of the Industrial Physician.* Pa. Med. J. Vol. XXI, No. 6, 378–381 (1918). It was recognized that companies should provide adequate medical facilities at work, that changes of work clothing should be furnished by the employer, that showers should be provided to reduce exposures, and that ventilation to remove hazardous dusts is recommended. *Id.* The need to keep clean work areas, to use wet methods, to use ventilation, to avoid dry sweeping during cleanup and to provide respirators was well known where toxic dusts were present. Miller, *The Health Hazards of Cigar Manufacturing with Suggestions for Obviating Them.* Pa. Med. J. Vol. XXI, No. 6; 360–364 (1918).

[88] Pennsylvania Department of Labor and Industry, Safe Practices Bulletin No. 93, "Occupational Disease Prevention: Exhausting Asbestos Fiber and Dust in Wire Insulation Manufacture," April 1942.

asbestos textile plant.[89] They did not have definitive proof this occurred, but by 1942, Hueper, then director of occupational cancer studies at the National Cancer Institute, concluded the available data was sufficient for him to publish that asbestos caused lung cancer.[90] This was repeated in the scientific literature several times in the 1940s and early 1950s. In 1955, should there have been any question in anyone's mind, Doll reported on lung cancer in excess in Great Britain due to asbestos.[91] Interestingly, this data came from the Turner and Newall Company, where lung cancer cases and pleural cancers had been accumulating since the 1920s, but had not been previously reported.[92]

66. Case reports about mesothelioma began accumulating in the 1940s, and by the early 1950s there were studies relating asbestos to the development of this form of malignancy. The evidence linking cancer to asbestos was strong enough that the Journal of the American Medical Association (JAMA), among the most prestigious medical journals in America, published an editorial on the topic in 1949.[93] The JAMA article serves as a benchmark for general acceptance that asbestos was a carcinogen. By the middle 1950s, asbestos was "known" as a cause of cancer[94] in the industrial hygiene community and it was clearly recognized that the Threshold Limit Values (TLVs) and Maximum Allowable Concentrations (MACs) were not aimed at preventing cancer. By 1958, the American Industrial Hygiene Association (AIHA) published that exposure to asbestos, including during gasket, packing and brake work, was associated with asbestosis and lung cancer.[95] The work of Wagner et al. (1960) in South Africa, clearly related exposure to crocidolite asbestos to the development of this disease, and cited earlier cases.[96] Interestingly, the cases reported by Wagner included not only mineworkers, but also included family members of occupationally exposed workers and environmentally exposed patients.

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[89] Lynch et al., *Pulmonary Asbestosis III: Carcinoma of Lung in Asbestos-Silicosis.* Am. J. Cancer. 24:56 (1935).
[90] Hueper, Occupation Tumors and Allied Diseases. (C.C. Thomas, Springfield, 1942).
[91] Doll, *Mortality from Lung Cancer in Asbestos Workers.* Br. J. Ind. Med. 12 (2):81-86 (1955).
[92] Tweedale, *The Rochdale Asbestos Cancer Studies and the Politics of Epidemiology: What You See Depends on Where You Sit*, Int. J. Occup. Environ Health 13: 70–79 (2007).
[93] J.A.M.A., Editorial, *Asbestosis and Cancer of the Lung*, (August 13, 1949). This editorial discusses pleural and lung cancer and considers both human and animal data.
[94] Cook, *Symposium on Threshold Limits – Present Trends in MAC's.* Ind. Hyg. Quarterly (Sept. 1956) (recognizing the TLVs hadn't addressed the "perplexing problems" of "cancerigens" and listing asbestos among the known causes of cancer).
[95] AIHA Hygienic Guides, Asbestos (1958). The AIHA Hygienic Guides were available to anyone who wanted them for $0.25/each. It had been recognized that asbestos from brake linings, gasket and packing caused asbestosis as early as 1932. (Merewether, E.R.A. Memorandum on the Industrial Diseases of Silicosis and Asbestos, Her Majesty's Stationery Office (1932)).
[96] Wagner et al., *Diffuse Pleural Mesothelioma and Asbestos Exposure in North Western Cape Province.* Br. J. Ind. Med. 17 (4):260-271 (1960) (reporting on cases of mesothelioma due to occupational, household and environmental exposures to asbestos).

may be taken up by macrophages. Other fibers may work their way into the interstitium or make their way to the lymph nodes. But there are fibers from each exposure that may make their way to the pleura, which is comprised of mesothelial cells – the target cells for mesothelioma. Additionally, asbestos fibers that do not reach the tumor site can and do release cytokines that may affect cell division. Because at its simplest definition, cancer is uncontrolled cell divisions, even asbestos fibers that do not reach the tumor site may play a role in causing or accelerating cancer. There is evidence that exposure to asbestos increases the rate of cell division, and so can be considered both an initiator and a promoter.

420. If a person is exposed to fewer asbestos fibers, then there will be fewer fibers that ultimately make their way to the pleura. Conversely, if a person is exposed to more asbestos fibers, there will be more fibers that make their way to the pleura. This is the nature of the dose-response relationship between asbestos exposure and mesothelioma: the more asbestos exposure a person has, the greater the chance of developing mesothelioma. In a person who develops mesothelioma, that disease is the result of the cumulative amount of asbestos and the risk of getting the disease increases with each exposure.

421. This affidavit represents a summary of my opinions based on my education, training, and experience and on the literature and documents cited. While I do not agree with every sentence of every document cited herein, these publications are authoritative for the propositions for which I cited them. Many of these articles, publications, and documents are cited by myself and other authors in published, peer-reviewed publications. I believe these publications are generally reliable, although I may not agree with every sentence in a publication, and are of the type relied upon by legitimate experts in asbestos and asbestos-related disease.

Arthur L. Frank MD

SWORN TO AND SUBSCRIBED
before me this 20th day of Dec, 2016.

Dawn M. Cloyd
NOTARY PUBLIC

My commission expires: July 28, 2018

(SEAL)

EXHIBIT I

GENERAL SPECIFICATIONS FOR MACHINERY

Bureau of Engineering, Navy Department

SUBSECTION S1-1 PLANS

1 December 1936

(Superseding Subsection S1-1, Plans, dated 1 July 1933)

NOTE.- Plans for the machinery, electrical equipment, and accessories of vessels building for the Navy are always of a confidential nature. Care shall be observed that they do not fall into the hands of unauthorized persons, especially those not citizens of the United States.

The following is quoted from an act approved June 15, 1917:

" * * whoever, lawfully or unlawfully, having possession of, access to, control over, or being intrusted with any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, or note relating to the national defense, willfully communicates or transmits or attempts to communicate or transmit the same to any person not entitled to receive it, or willfully retains the same and fails to deliver it on demand to the officer or employee of the United States entitled to receive it; or whoever, being intrusted with or having lawful possession or control of any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, note, or information, relating to the national defense, through gross negligence permits the same to be removed from its proper place of custody or delivered to anyone in violation of his trust, or to be lost, stolen, abstracted, or destroyed, shall be punishable by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or both. * * * "

S1-1-2. GENERAL REQUIREMENTS.

References: (a) Federal Specifications CCC-C-531, Tracing Cloth.
(b) List of Bureau standard plans, see Appendix I.

1. All drawings of machinery and accessories under the cognizance of the Bureau of Engineering, which shall be furnished by and at the expense of the contractor, are grouped under the following general classification:

(a) Type A drawings.- Preliminary drawings, submitted with bids or prior to award of contract.

(b) Type B drawings.- Development or working drawings, submitted for approval subsequent to award of contract, but prior to ordering material or commencing work.

EXHIBIT 7

10. The Bureau will supply a set of blank index forms for type D drawings which will be filled in by the shipbuilder with india ink, after which the shipbuilder will make blue-line print copies of these forms for each set of plans; the indexed forms will be forwarded to the Bureau with the set of type D drawings intended for the Bureau's files, and set of blue-line copies will accompany each other set of these drawings.

11. Each set shall be wrapped in a waterproof wrapper and be packed separately, ready for shipment, in flat, strong, wooden cases, in which the sheets shall be so secured that it will be impossible for them to be displaced or crumpled during handling. Sets of machinery, electrical, and radio drawings for the same vessel may be boxed together.

12. In the purchase of equipment for vessels by direct contract with the Bureau type D drawings conforming to the requirements of the above para- Add the following as new subparagraph 13:- ... completed

"13. No type D finished plans will be required for the interior communication equipment listed in subparagraph S1-1-h-6(z)." (74)

S1-1-h. INSTRUCTION BOOKS AND DIAGRAMS.

1. Instruction books will be furnished by contractors and subcontractors for main propelling machinery, boilers, air compressors, forced draft blowers, ~~reciprocating pumps~~, centrifugal pumps as required by Subsection S47-3, positive displacement rotary pumps as required by Subsection S47-3 and other auxiliary machinery, electrical installations and other important naval equipment furnished by them. These instruction books will contain all necessary pertinent information to insure efficient and economical use of the equipment, such data and information as may be required by the applicable specifications under which furnished, and in general, the following:-

(a) General Description, including also sufficient sketches, illustrations, and sectional assemblies with appropriate references to drawing numbers and titles.

(b) Installation instructions.

(c) Operating instructions.

(d) Instructions for care and maintenance.

(e) Safety precautions.

~~(f) Spare parts lists.~~ provide no. 71

(f) Index.

Books will be printed on a strong grade of ... S1-1-h-6(z)

"2. For interior communication equipment listed in subparagraph S1-1-h-6(z) reproductions of approved type B plans."

2. The instruction books shall be covered with a strong durable cover of black leather, leatherette, fabrikoid or similar approved material and shall be bound securely so as to prevent detachment of either the covering or the pages. The size of the cover shall be approximately 9-inches x 11-inches. The front cover shall contain the following information:

(a) Sufficient descriptive data to enable ready identification.

(b) Name and number of all vessels to which the equipment applies.

(c) Contract numbers under which equipment was purchased. If more than one contract number is shown, the vessels supplied under each contract shall be indicated.

(d) Manufacturer's name and address.

A sample of the complete book shall be submitted to the Bureau for approval before final printing.

3. A contractor furnishing more than one set or type of equipment, subject to Bureau approval, may incorporate the instruction books of similar or allied equipment in one binder, providing the binder does not become bulky and more difficult to use.

4. The Bureau will consider requests by contractors in special cases to furnish descriptive pamphlets instead of instruction books. Such pamphlets shall contain sufficient information to insure that the operating personnel can operate and maintain the equipment properly. The pamphlets shall be bound in a durable cover as described in subparagraph 51-1-h-2 above.

5. All copies of instruction books required shall be delivered to the inspector of machinery prior to the delivery of each vessel. Sufficient copies shall be supplied for distribution by the inspector of machinery as follows:

(a) Five to the Bureau of Engineering.

(b) Ten to the commanding officer of each vessel, in the case of battleships, cruisers, and aircraft carriers, and five for each other type of vessel.

(c) Two to the Superintendent of the United States Naval Academy.

6. Instruction books shall in all cases be furnished for the following (74d)

(1) Two of equipment listed in subparagraph 51-1-h-6(d) to each navy yard.

(a) Electrical propulsion equipments for all classes of vessels.

(b) Oil engines of all types, whether for propulsion purposes or not.

(c) Gasoline engines of all types.

(d) Main propulsion turbines.

Bureau of Ships Ad Interim Specification

BOOKS, INSTRUCTION

Preparation, Contents, and Approval

A. APPLICABLE SPECIFICATIONS AND PUBLICATION.

A-1. *Specifications.*—The following Navy Department specifications, of the issue in effect on date of invitation for bids, form a part of this specification, and bidders and contractors should provide themselves with the necessary copies:

General Specifications for Inspection of Material.

39P16—Packaging and packing for overseas shipment:

Section V—Boxes, wood, cleated, plywood (JAN–P–105).

Section VI—Boxes, wood, nailed (JAN–P–106).

Section VII—Boxes, wood, wirebound (JAN–P–107).

Section XXV—Barrier materials, waterproof, flexible (JAN–P–126).

A-2. *Publication.*—The following publication, of the issue in effect on date of invitation for bids, forms a part of this specification, and bidders and contractors should provide themselves with the necessary copies:

NAVEXOS P-29—Security Measures for the Protection of Classified Printed Matter During Production.

B. TYPES.

B-1.—Instruction books shall be furnished in the following types, as specified in the contract or order or in the applicable equipment specifications:

Type A (see par. E–1).
Type B (see par. E–2).
Type C (see par. E–3).
Type D (see par. E–4).

C. MATERIAL AND WORKMANSHIP.

C-1. *Material.*—When materials specified are not available, adequate substitutes may be used provided they have been approved by the bureau concerned.

C-2. *Workmanship.*—The workmanship shall be of high quality comparable in text compilation, arrangement, and accuracy to high-grade, commercial instruction books and parts catalogs. Copy which has filled letters or is blurred will not be accepted. The workmanship shall be to the satisfaction of the cognizant section in the bureau concerned.

D. GENERAL REQUIREMENTS (Not applicable to Type D books).

D-1. *Contents.*—Instruction books on specific equipments shall be logically arranged and shall contain all of the information required in the following paragraphs, preferably in one of the following arrangements:

D-1a. *First arrangement.*—

D-1a(1). Title page.

D-1a(2). Serial numbers of equipments wherever applicable.

D-1a(3). Table of contents.

D-1a(4). List of illustrations.

D-1a(5). *Chapter 1, Introduction.*—This chapter shall include a general description of the equipment, i. e., tell briefly what it is, where it is used, and what it will do, also all information of a general character applicable to the complete equipment. In addition, the description should include a complete list of the equipment with pertinent ratings.

D–1a(6). *Chapter 5, Detailed Description.*—This chapter shall contain a complete detailed description of component assemblies and accessories which comprise the complete equipment; for example, in the case of a ship's service turbine generator set, the turbine, the gear, the generator, the exciter, and the voltage regulator. Integrated with the physical description shall be a description of the mechanical and electrical operation of the component assemblies and accessories. Allowable clearances, temperatures, tolerances, weights, etc., shall be shown in tabular form.

D–1a(7). *Chapter 3, Principles of Operations.*—This chapter shall contain a brief résumé of the principles of operation, together with such illustrations, sketches and internal wiring diagrams as are considered necessary to the prompt comprehension of equipment of new design or application. (For example, if the instruction book covers or includes rotary amplifiers—or other equipment of relatively new design—complete information covering their principles of operation should be given in this chapter.)

D–1a(8). *Chapter 4, Operating Instructions.*—This chapter shall cover complete instructions for the operation of the equipment, including precautions and tests which should be made before initial starting after installation or after a major overhaul. These precautions and tests should be clearly designated and should be the first information presented in this chapter. Where operations are to be performed in specified sequence, step-by-step procedure shall be used. Operations should be numbered in the order in which they are to be performed. Operating data which is frequently referred to in operating the equipment should be included in this chapter.

D–1a(9). *Chapter 6, Maintenance.*—This chapter shall include all the necessary instructions for the proper care and maintenance of the equipment, *i. e.*, instructions for inspecting, cleaning, lubricating, adjusting, disassembling, assembling, and repairing the equipment covered by the instruction book. The instructions shall be logically arranged and shall tell what, when, and how to perform each of these operations. Such expressions as "replace bent or worn parts when discovered" shall be avoided, if possible, and specific parts which may become bent or worn shall be mentioned. The instruction on lubrication shall include information regarding lubrication recommended by the manufacturer, the type of lubricant to be used, together with specific time periods. This may be shown in tabular form. The number and types of lubricants required shall be held to a minimum. Lubricants shall be described by Navy specification numbers where applicable, and by commercial designations.

D–1a(10). *Complete Parts List.*—If the contract or order requires a Complete Parts List, it may be inserted in the instruction book immediately following Chapter 5. If, however, the complete parts list and/or the instruction book is of such thickness that the addition of the parts information would make the final book contain over 400 pages, then, the parts list shall be contained in a separate volume.

D–1a(11). *Plans.*—Immediately following Chapter 5 (or the complete parts list) such plans as are required shall be included in the instruction book. In cases where reduced size reproductions of standard approved plans are used as illustrations in connection with the text, these plans may be inserted throughout the text near the places where referenced.

D–1a(12). *Appendix.*—The appendix shall include such information as test data, contract guarantees, the numbers of the drawings containing the basic-plan list, and similar information when specified by the contract or order.

D–1b. *Second arrangement.*—

D–1b(1). Title page.

D–1b(2). *Introduction.*—The introduction shall give a brief general outline of the purpose of the manual with a brief discussion of its contents.

D–1b(3). *Table of contents.*—The table of contents shall be a general index by sections.

D–1b(4). *Section 1, Description and Arrangement of Units.*—This section shall contain a general discussion of the equipment.

D–1b(5). *Section 2, Specifications.*—This section shall give general data, pump capacities, engine rating, recommended operating data, clearance tolerances, etc.

D–1b(6). *Section 3, Installation.*—This section shall give methods of installation, alignment, adjustments, precautions, etc.

D–1b(7). *Section 4, Operation.*—This section shall describe starting procedure, stopping procedure, idling, and normal operating routine.

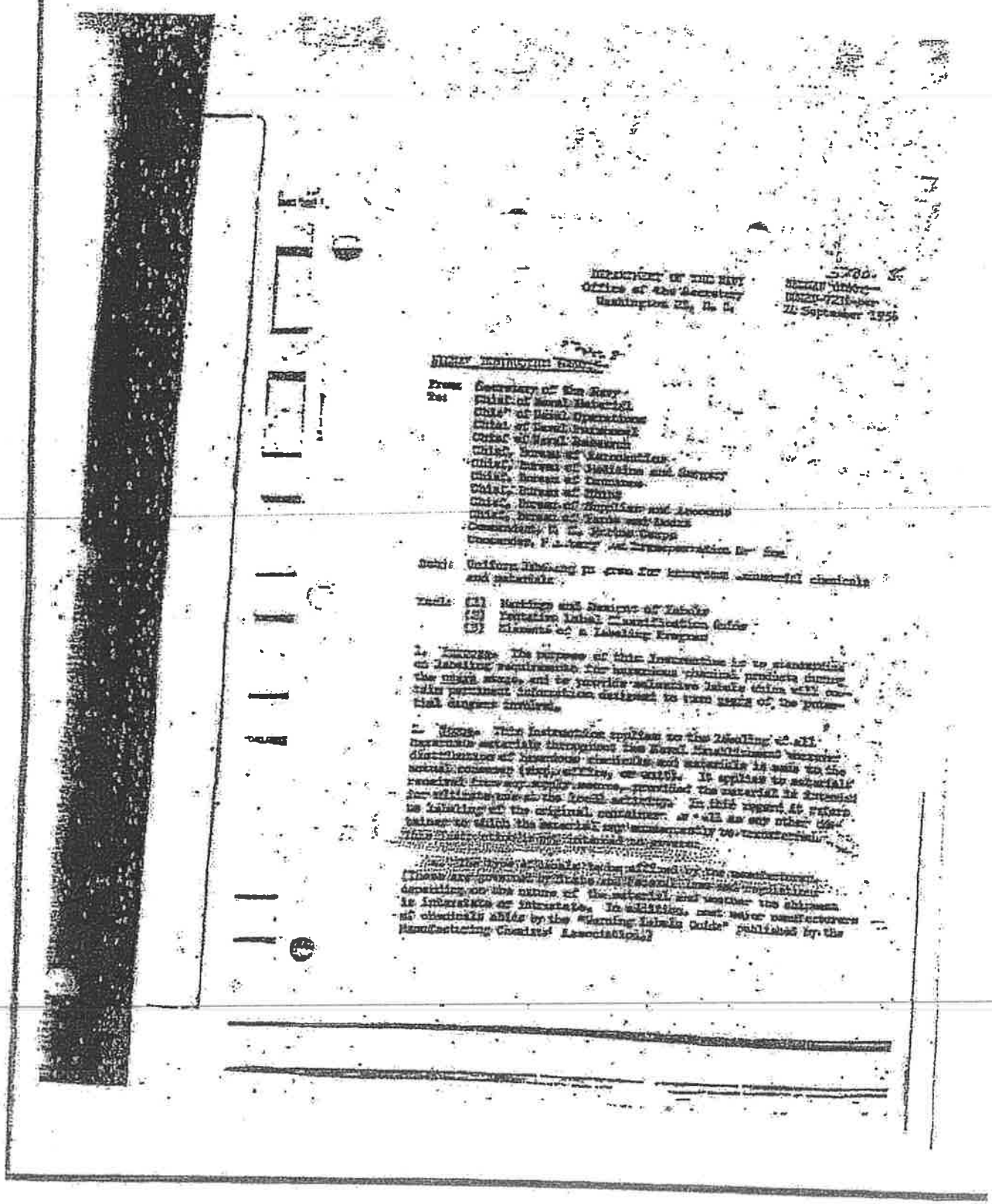
D–1b(8). *Section 5, Inspection, Maintenance, and Adjustments.*—This section shall include general inspection and maintenance schedules—no detailed procedures involving overhaul—but a general schedule as to when various operations should be performed.

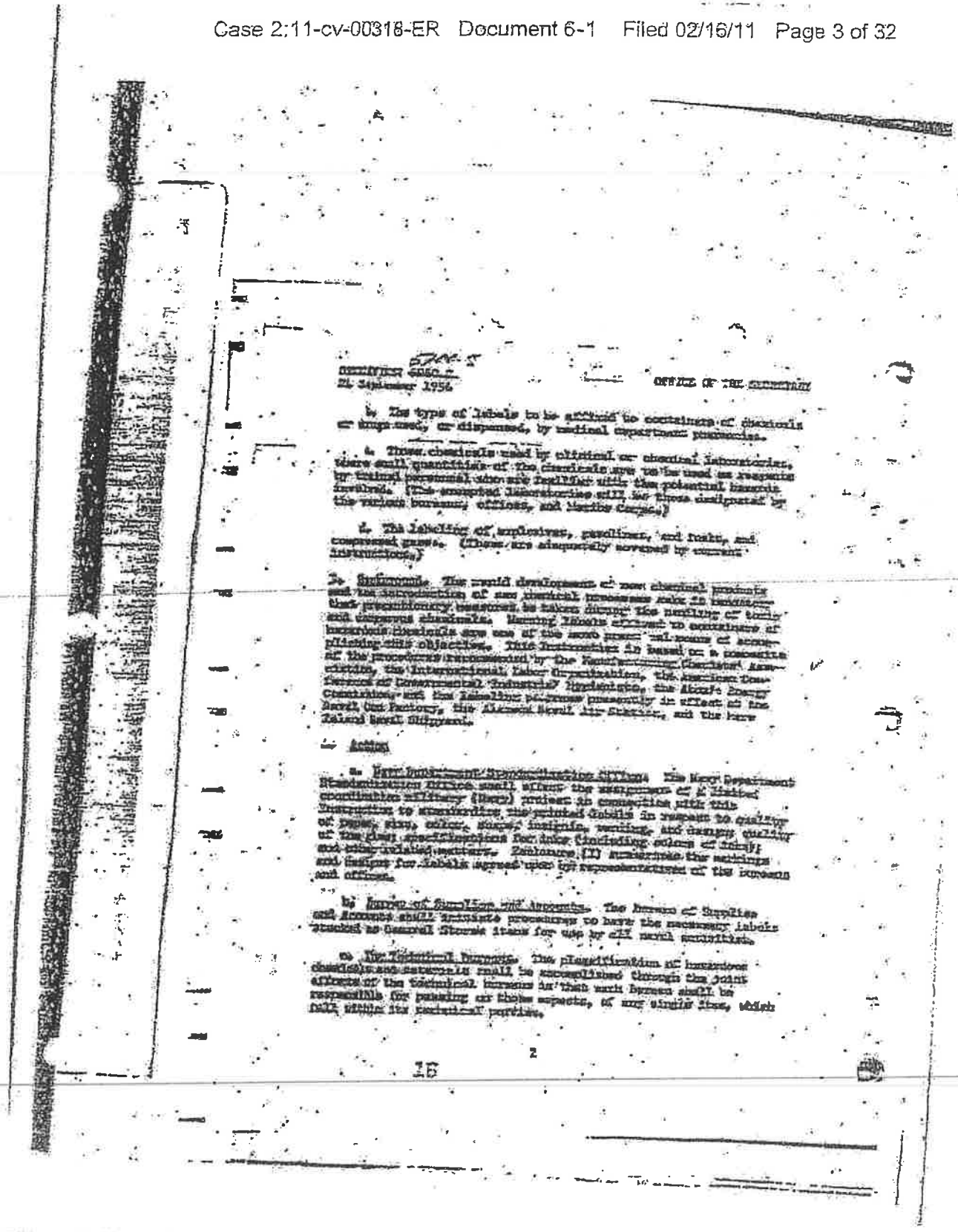
D–1b(9). *Section 6, Cylinder Block.*—

D–1b(10). *Section 7, Cylinder Liners.*—

D–1b(11). *Section 8, Pistons.*—

D–1b(12). *Section 9, Cylinder Head.*—





NAVMEDICOM 5060.1
21 September 1956

OFFICE OF THE SECRETARY

b. The type of labels to be affixed to containers of chemicals or drugs used, or dispensed, by medical department personnel.

4. Those chemicals used by clinical or chemical laboratories, where small quantities of the chemicals are to be used as reagents by trained personnel who are familiar with the potential hazards involved. (This accepted laboratories will be those designated by the various bureaus, offices, and Medical Corps.)

5. The labeling of explosives, gasolines, and fuels, and compressed gases. (These are adequately covered by current instructions.)

3. Safeguards. The rapid development of new chemical products and the introduction of new chemical processes make it necessary that precautionary measures be taken during the handling of toxic and dangerous chemicals. Warning labels affixed to containers of hazardous chemicals are one of the most practical means of accomplishing this objective. This instruction is based on a composite of the procedures recommended by the Manufacturing Chemists' Association, the International Labor Organization, the American Conference of Governmental Industrial Hygienists, the Atomic Energy Commission, and the Labeling provisions presently in effect at the Naval Gun Factory, the Naval Air Stations, and the Navy Yard Puget Sound.

4. Action.

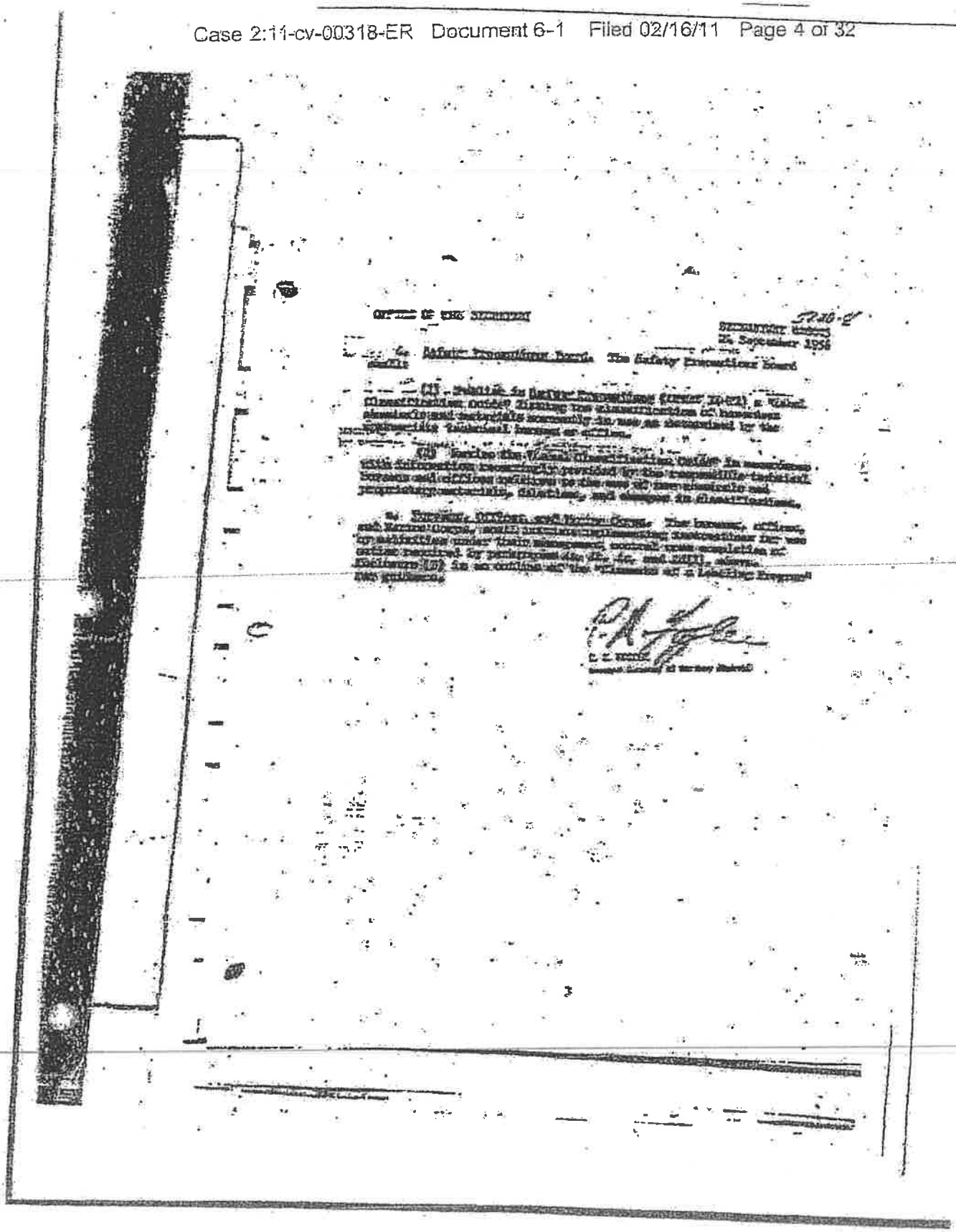
a. Navy Procurement Specification Officer. The Navy Department Standardization Office shall effect the assignment of a limited coordination activity (Navy) project in connection with this instruction to standardize the printed labels in respect to quality of paper, size, color, stock, insignia, wording, and design, quality of the glue; specifications for inks (including colors of inks); and other related matters. Enclosure (1) enumerates the markings and designs for labels agreed upon by representatives of the bureaus and offices.

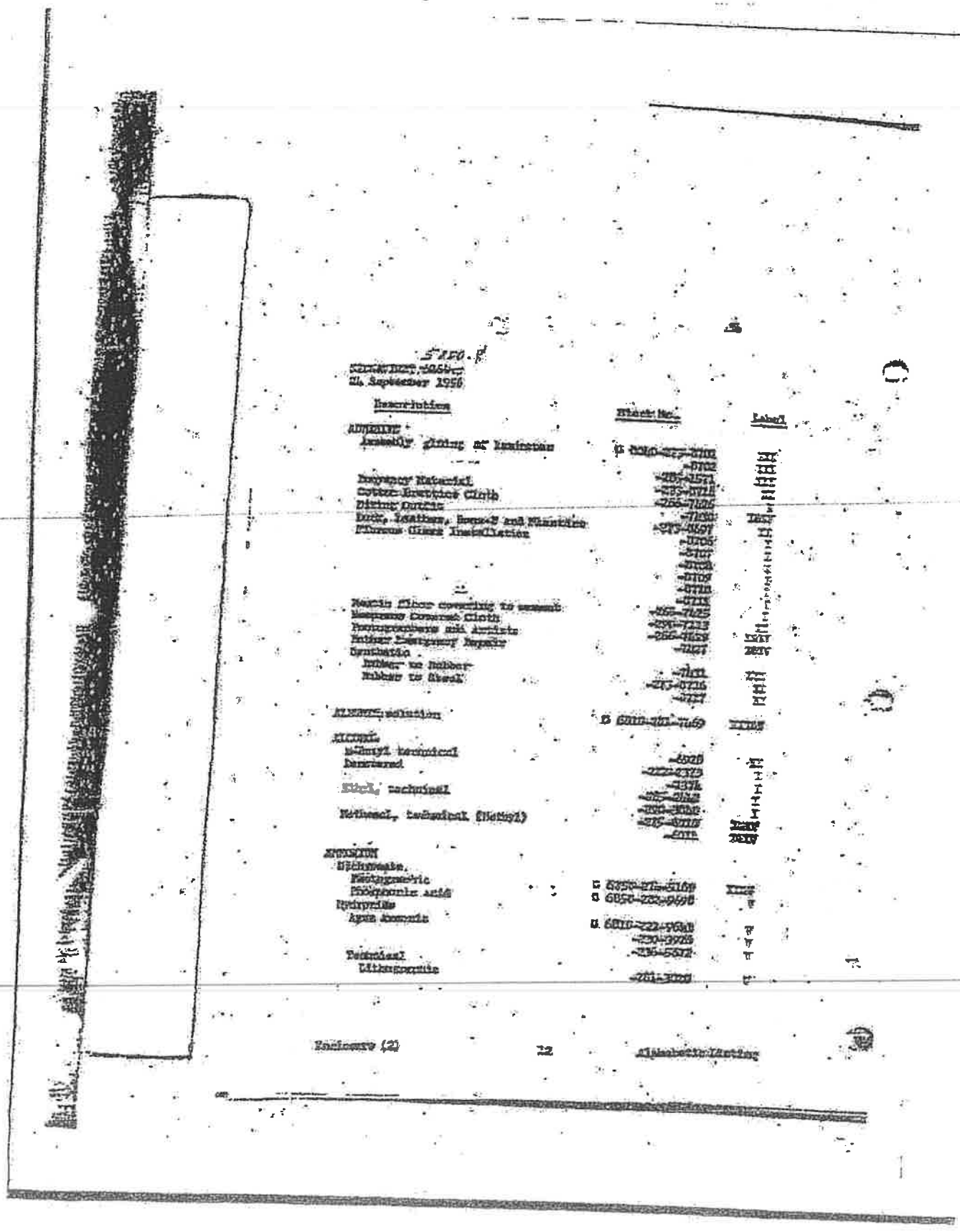
b. Bureau of Supplies and Accounts. The Bureau of Supplies and Accounts shall initiate procedures to have the necessary labels stocked as General Stores items for use by all naval activities.

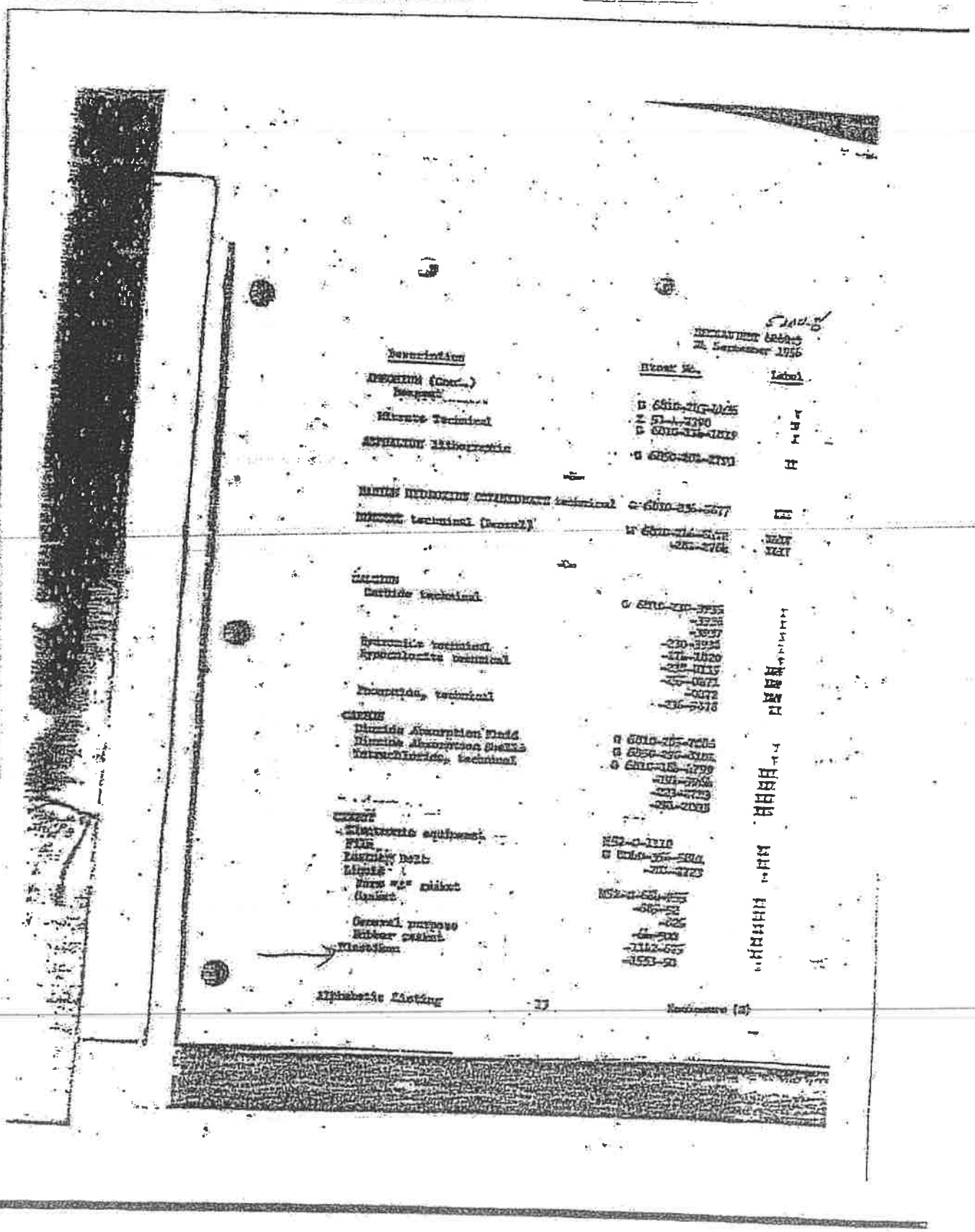
c. The Technical Bureaus. The classification of hazardous chemicals and materials shall be accomplished through the joint efforts of the technical bureaus in that each bureau shall be responsible for passing on those aspects, of any single item, which fall within its technical purview.

2

16







Elements of a Labeling Program

1. General. All materials should be labeled whether or not they are considered toxic, flammable, or explosive. This is desirable, not only to prevent untoward accidents but also to conserve material which would otherwise be discarded and wasted if unlabeled. Hazardous chemicals and materials within the scope of this instruction have been grouped into the general classifications defined as follows:

a. Class I. Fire Hazard (Flammable). Any material which alone or in combination with other materials may produce a danger of fire or explosion (such as the strong oxidizing agents, perchlorates, peroxides, nitrates, acetone, ether, etc.).

b. Class II. Toxic and Fire Hazard. Any material which presents a combined hazard due to its flammability (Class I) and its toxicity (Class III).

c. Class III. Toxic. Any industrial or military material which may give off a harmful vapor, dust, fume, or mist during handling or operations. The injurious effect may arise from one exposure (acute) or from repeated exposures over a prolonged period (chronic). The mode of entry into the body may be by ingestion, inhalation, or absorption through the skin. Examples of this class are chlorinated hydrocarbons (carbon tetrachloride, tetrachloroethylene, trichloroethylene), chlorinated diphenyls, compounds of cadmium, mercury, chromium, lead, and organic phosphorus compounds.

d. Class IV. Poisonous. A poison is commonly understood to be a product which will lead to fatal results in a short period of time when taken into the body. Oral intake is the primary mode of entry into the body. It is now recognized that other routes such as inhalation and absorption through the skin may produce the same effect as oral ingestion of some materials. Examples of this category are cyanides, arsenicals, carbon disulfide, and dimethyl sulphate. Some of these materials may give off a deadly vapor when mixed with acids; e.g., cyanide and acids.

e. Class V. Corrosive. Agents which in contact with tissues of the body surface will cause injury or destruction of those tissues. Among these are corrosive agents such as hydrochloric, acetic, nitric, and sulfuric acids; and sodium, potassium, and ammonium hydroxides.

[redacted]

21 September 1956

2. Class V. Radioactive Hazards. Hazardous materials or chemicals which emit alpha, beta, gamma, or neutron radiation, or which may give off dusts, fumes, gases, or vapors emitting these radiations.

3. It may be necessary on occasion for qualified investigators to work with new products before adequate chemical, physical, and toxicological data are available. To cover such cases, and such cases only, the following guide is suggested for preparing labels to be used during the period of investigation.

[redacted]

4. The elements of an effective labeling program consist of:

a. Establishment of a Chemical Control Committee.

b. Uniformity of labeling.

c. Ordering of materials and their labeling category.

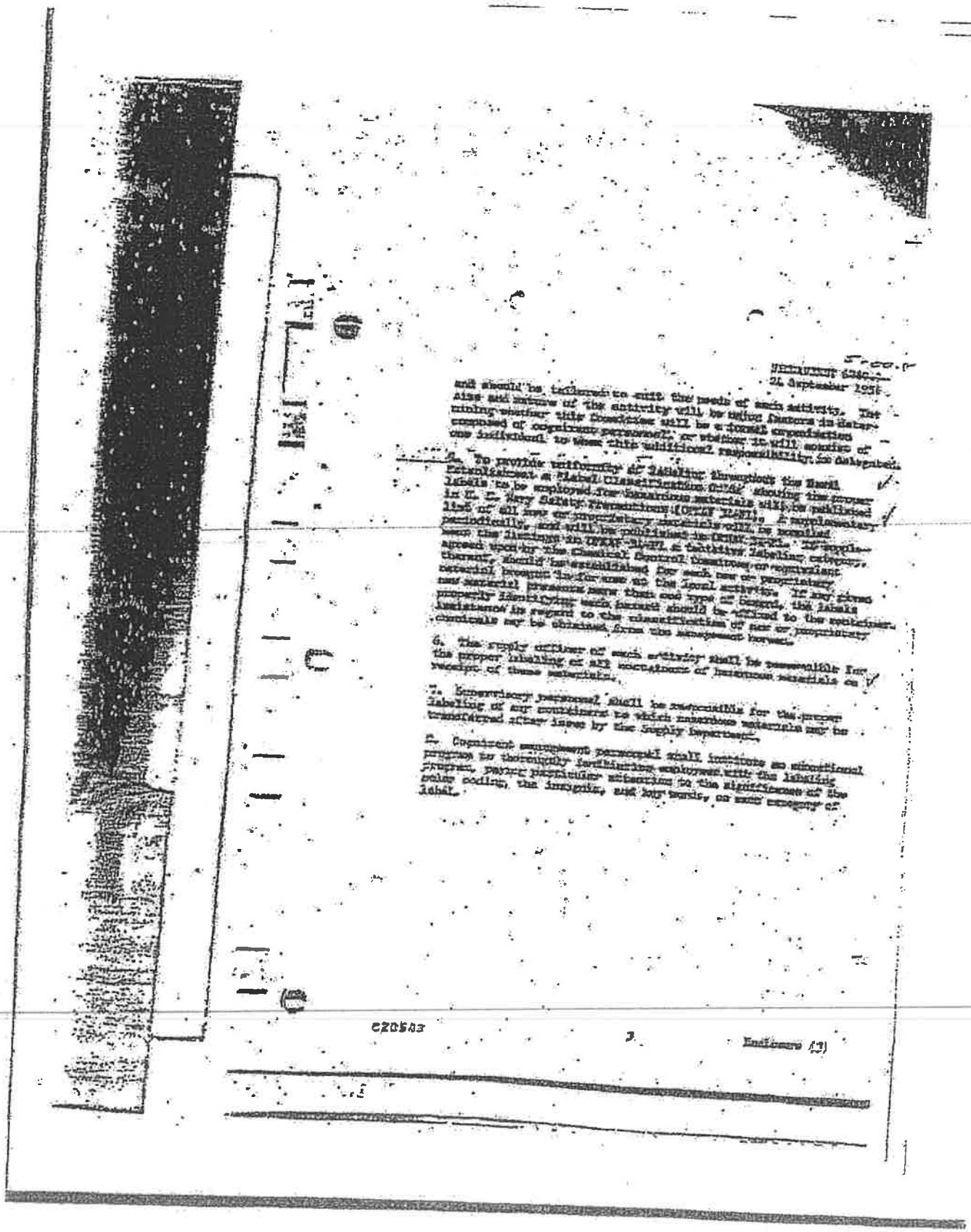
d. Proper labeling by the local supply department.

e. Proper labeling by the using unit where transfer is made to smaller containers.

f. Educational programs.

5. A Chemical Control Committee or equivalent channel should be established as some authority to administer the technical phases of the labeling program for the local authority and to make revisions as necessary to keep the program current. Directives should be prepared by the Chemical Control Committee for presignature by the commanding officer. These would be based on current inspections

Enclosure (3) 2



and should be tailored to suit the needs of each activity. The size and nature of the activity will be major factors in determining whether this committee will be a formal organization composed of cognizant personnel, or whether it will consist of one individual to whom this additional responsibility is delegated.

5. To provide uniformity of labeling throughout the Naval Establishment a Hazard Classification Guide showing the proper labels to be employed for hazardous materials will be published in U. S. Navy Safety Precautions (OPNAV 34P1). A supplementary list of all new or proprietary materials will be compiled periodically, and will be published in OPNAV 34P1. A supplement to the listings in OPNAV 34P1, a tentative labeling category, agreed upon by the chemical hazard committee or equivalent thereof, should be established for each new or proprietary material brought in for use at the local activity. If any given material presents more than one type of hazard, the labels properly identifying each hazard should be affixed to the container. Assistance in regard to the classification of new or proprietary chemicals may be obtained from the management bureau.

6. The supply officer of each activity shall be responsible for the proper labeling of all containers of hazardous materials on receipt of these materials.

7. Supervisory personnel shall be responsible for the proper labeling of any containers to which hazardous materials may be transferred after issue by the supply department.

8. Cognizant management personnel shall institute an educational program to thoroughly familiarize employees with the labeling system, proper precautions pertaining to the significance of the color codes, the insignia, and key words, or any exception of label.

C20503 3 Enclosure (1)

East Pittsburgh, 2-6-52
Industrial Hygiene Laboratory

June 11, 1952

SOUTH PHILADELPHIA WORKS
Industrial Relations
Mr. M. E. McKeldin
Safety Supervisor

With respect to the room in which asbestos cloth is being cut and sewed, the air samples did not indicate exposure to concentrations of asbestos dust above 5 millions particles per cubic foot, which is presently regarded as the maximum allowable concentration. However, I have a feeling that these concentrations may vary from time to time in the room. It would be very desirable to ventilate the room more effectively so that the amount of asbestos dust in the breathing atmosphere would be further reduced. When sheet material is being thrown from one bench to another, the concentrations of asbestos fibers in the breathing atmosphere of the sewer in particular would appear to be potentially hazardous. As you know, in the State of Pennsylvania, when a person's chest contains some silicosis and it becomes superimposed with tuberculosis, that this disease becomes compensable. I believe that the same is true in the case of asbestosis. Frequently, the early stages of asbestosis or silicosis are difficult to detect by X-rays and it is also believed that persons suffering from beginning stages of asbestosis or silicosis are more likely to develop tuberculosis. We have such a case in Compensation Court from one of our plants at the present time and they are difficult cases to handle.

As you know, the present fan in the side wall of this room is quite noisy and the men do not operate it more than necessary on account of the noise situation. Therefore, the ventilation of this room should be reconsidered. In the revision of the ventilation of this room, it might be most desirable to have the fan placed on the side of the room with the large number of windows since a good portion of the dust already is moving in this direction. It would be desirable to use a different type of fan in the improvement of this room. By placing the fan on the side wall presently containing most of the windows, the dust fibers collecting along this side of the wall would be ventilated to the outside of the building rather than dragged past the breathing level of the men doing the sewing.

I will greatly appreciate knowing what your final decision on this problem will be.

H. Wilbur Speicher, Administrator
Industrial Hygiene

H.W.S. These dust samples were found to contain extremely fine particles which would indicate their being more hazardous

HWS:

PLAINTIFF'S EXHIBIT 6985.0

IN RE: ABRAMS DECEMBER 1992

3760.8

DEPARTMENT OF THE NAVY
Office of the Secretary
Washington 25, D. C.

SECNAV ~~6250.7~~
DUNED-7231-bar
24 September 1956

SECNAV INSTRUCTION ~~6250.7~~

From: Secretary of the Navy
To: Chief of Naval Material
Chief of Naval Operations
Chief of Naval Personnel
Chief of Naval Research
Chief, Bureau of Aeronautics
Chief, Bureau of Medicine and Surgery
Chief, Bureau of Ordnance
Chief, Bureau of Ships
Chief, Bureau of Supplies and Accounts
Chief, Bureau of Yards and Docks
Commandant, U. S. Marine Corps
Commander, Military Sea Transportation Service

Subj: Uniform labeling program for hazardous industrial chemicals and materials.

Encl: (1) Markings and Design of Labels
(2) Tentative Label Classification Guide
(3) Elements of a Labeling Program

1. Purpose. The purpose of this Instruction is to standardize on labeling requirements for hazardous chemical products during the issue stage, and to provide selective labels which will contain pertinent information designed to warn users of the potential dangers involved.

2. Scope. This Instruction applies to the labeling of all hazardous materials throughout the Naval Establishment wherever distribution of hazardous chemicals and materials is made to the actual consumer (shop, office, or unit). It applies to materials received from any supply source, provided the material is intended for ultimate use at the local activity. In this regard it refers to labeling of the original container as well as any other container to which the material may subsequently be transferred. This Instruction is Not intended to govern:

a. The type of labels to be affixed by the manufacturer. (These are governed by State and Federal laws and regulations depending on the nature of the material and whether the shipment is interstate or intrastate. In addition, most major manufacturers of chemicals abide by the "Warning Labels Guide" published by the Manufacturing Chemists' Association.)

PLAINTIFF'S EXHIBIT A

5510-S

OFFICE OF THE SECRETARY

SECNAVINST 5510.7
24 September 1956

d. Safety Precautions Board. The Safety Precautions Board shall:

(1) Publish in Safety Precautions (OPNAV 34-P1) a "Label Classification Guide" listing the classification of hazardous chemicals and materials currently in use as determined by the appropriate technical bureau or office.

(2) Revise the "Label Classification Guide" in accordance with information recurringly provided by the responsible technical bureaus and offices relative to the use of new chemicals and proprietary materials, deletions, and changes in classifications.

e. Bureaus, Offices, and Marine Corps. The bureaus, offices, and Marine Corps, shall initiate implementing instructions for use by activities under their management control upon completion of action required by paragraphs 4a, 4b, 4c, and 4d(1), above. Enclosure (3) is an outline of the "Elements of a Labeling Program" for guidance.

P. A. Foster

R. B. FOSTER
Assistant Secretary of the Navy (Material)

MIL-B-15071(SHIPS)
1 April 1950
SUPERSEDING
3582(BuT)
1 July 1945

MILITARY SPECIFICATION

BOOKS, INSTRUCTION; PREPARATION, CONTENTS, AND APPROVAL

1. CLASSIFICATION

1.1 Types.- Instruction books shall be furnished in the following types as specified (see 6.1):

Type A - (Type A instruction books may be required where the system or equipment to be described is of a highly specialized or extremely complex nature, and where the importance of the equipment justifies unusual effort in the preparation of the instruction book.) (See 3.2.)

Type B - (Type B instruction books are required where the equipment or system to be described has no direct commercial counterpart or which is sufficiently complex that a detailed description, and maintenance instructions are required and must be supplemented by sufficient photographs, drawings, parts lists, etc.) (See 3.3.)

Type C - (Type C instruction books are required where the equipment or system to be described is an adaptation or variation of conventional commercial equipment, where with certain modifications and additional data, the type of instructional matter normally furnished will serve the purpose.) (See 3.4.)

Type D - (Type D instruction books are required where the equipment or system to be described is generally the same as equivalent commercial equipment, or is sufficiently simple that standard manufacturer's instruction pamphlets and service data are adequate.) (See 3.5.)

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS, AND DRAWINGS

2.1 Specifications.- The following specifications, of the issue in effect on date of invitation for bids, form a part of this specification:

Military Specifications
JAN-P-106 - Packaging and Packing for Overseas Shipment, Boxes; Wood, Cleated, Plywood.
JAN-P-108 - Packaging and Packing for Overseas Shipment, Boxes; Wood, Nailed.
JAN-P-107 - Boxes; Wood, Wire-Bound (Overseas Type).
JAN-P-126 - Packaging and Packing for Overseas Shipment, Barrier Materials, Waterproof, Flexible.
JAN-P-140 - Packaging and Packing for Overseas Shipment, Barrier Materials, Water-Resistant, Case-Liner.

Navy Department Specification
General Specifications for Inspection of Material

(Army.- Copies of specifications should be obtained from the procuring agency or as directed by that agency. Both the title and identifying number or symbol should be stipulated when requesting copies.)

GPO—O—NAY—1-71

Navy.- Copies of Military (including Joint Army-Navy and National Military Establishment specifications) and Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C., except that activities of the Armed Forces should make application to the Commanding Officer, Naval Supply Center, Norfolk 11, Va. Both the title and identifying number or symbol should be stipulated when requesting copies.)

Air Force.- Copies of Military specifications (including Joint Army-Navy and National Military Establishment specifications) may be obtained upon application to the Commanding General, Air Material Command, Wright-Patterson Air Force Base, Dayton, Ohio. Both the title and identifying number or symbol should be stipulated when requesting copies.)

(Marine Corps.- Copies of Military specifications (including Joint Army-Navy and National Military Establishment specifications) may be obtained upon application to the Quartermaster General, Headquarters U.S. Marine Corps, Navy Department, Washington 25, D. C. or the Depot Quartermaster, Marine Corps Depot of Supplies, 1100 South Broad Street, Philadelphia 46, Pa. Both the title and identifying number or symbol should be stipulated when requesting copies.)

2.2 Other publications.- The following publications, of the issue in effect on date of invitation for bids, form a part of this specification:

Navy Administrative Office Publication
NAVEXOS P-29 - Security Measures for the Protection of Classified Printed Matter During Production.

(Copies of Publication NAVEXOS P-29 may be obtained upon application to the Administrative Office, Navy Department, Washington 25, D. C.)

Bureau of Supplies and Accounts Publication
Navy Shipment Marking Handbook.

(Copies of the Navy Shipment Marking Handbook should be obtained from the sources given for obtaining specifications.)

2.3 Drawings.- The following drawing, of the issue in effect on date of invitation for bids, forms a part of this specification:

Bureau of Ships Drawing
S0103-79729 -- Standard Drawing Format for Production Drawings.

(Copies of Bureau of Ships drawings may be obtained only upon application to the Bureau of Ships, Navy Department, Washington 25, D. C. Both the title and identifying number or symbol should be stipulated when requesting copies.)

3. REQUIREMENTS

3.1 Material.- The minimum material requirements are as specified hereinafter. A good grade material shall be used when a definite material is not specified.

3.2 Type A instruction books.- Type A instruction books shall be as specified in the individual contract or order (see 6.1).

3.3 Type B instruction books.-

3.3.1 Contents.- Type B instruction books shall contain the following information as applicable, presented in a logical arrangement (see figs. 1 to 8, inclusive):

(a) Title page (see fig. 2).
(b) General data (see 3.3.1.1).
(c) Table of contents, listing all divisions and primary and secondary subdivisions (such as chapters, sections, etc.) with their corresponding page numbers.
(d) List of illustrations and plans, specifying titles, figure numbers and pages on which such illustrations appear.
(e) Introduction (see 3.3.1.2).
(f) Detailed description (see 3.3.1.3).
(g) Installation instructions (see 3.3.1.4).
(h) Adjustments and tests (see 3.3.1.5).
(i) Principles of operations (see 3.3.1.6).
(j) Operating instructions (see 3.3.1.7).
(k) Maintenance (see 3.3.1.8).
(l) Parts identification (see 3.3.1.9).
(m) Drawings (see 3.3.1.10 and 3.3.2.4.6.4).
(n) Memorandum pages (see 3.3.1.11).

NOTE: Although these requirements are directly applicable to instruction books covering specific equipment, they shall be followed as closely as possible for instruction books covering systems, such as engineering piping systems. When an instruction book covers a system or an equipment composed of several distinct units (for example, a generating set consisting of a diesel engine, a generator, a voltage regulator, and a controller), it may be desirable to arrange the book in major divisions, each covering one unit. If so, the major divisions may be arranged by sub-divisions, each corresponding to the requirements herein.

3.3.1.1 General data.- This division shall contain data such as the following:

(a) Safety notice (where high voltages or special hazards are involved).
(b) Component list containing:
    Description of item.
    Navy type designation.
    Navy or bureau or agency stock number (if available).
    Dimensions.
    Weight (with or without packing).
(c) Input power requirements and heat dissipation.
(d) Salient design characteristics.
(e) Electron tube complement.
(f) Serial number (if appropriate).

3.3.1.2 Introduction.- This division shall include a general description of the equipment, i.e., explain briefly what it is, where it is used, and what it will do, also all information of a general character applicable to the complete equipment. When the text contains technical terms or terms not commonly used, definitions shall be included.

(Navy.- Copies of Military (including Joint Army-Navy and National Military Establishment specifications) and Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C., except that activities of the Armed Forces should make application to the Commanding Officer, Naval Supply Center, Norfolk 11, Va. Both the title and identifying number or symbol should be stipulated when requesting copies.)

(Air Force.- Copies of Military specifications (including Joint Army-Navy and National Military Establishment specifications) may be obtained upon application to the Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio. Both the title and identifying number or symbol should be stipulated when requesting copies.)

(Marine Corps.- Copies of Military specifications (including Joint Army-Navy and National Military Establishment specifications) may be obtained upon application to the Quartermaster General, Headquarters U.S. Marine Corps, Navy Department, Washington 25, D. C. or the Depot Quartermaster, Marine Corps Depot of Supplies, 1100 South Broad Street, Philadelphia 46, Pa. Both the title and identifying number or symbol should be stipulated when requesting copies.)

2.2 Other publications.- The following publications, of the issue in effect on date of invitation for bids, form a part of this specification:

Navy Administrative Office Publication
NAVEXOS P-29 - Security Measures for the Protection of Classified Printed Matter During Production.

(Copies of Publication NAVEXOS P-29 may be obtained upon application to the Administrative Office, Navy Department, Washington 25, D. C.)

Bureau of Supplies and Accounts Publication
Navy Shipment Marking Handbook.

(Copies of the Navy Shipment Marking Handbook should be obtained from the sources given for obtaining specifications.)

2.3 Drawings.- The following drawing, of the issue in effect on date of invitation for bids, forms a part of this specification:

Bureau of Ships Drawing
SU103-73729 - Standard Drawing Format for Production Drawings.

(Copies of Bureau of Ships drawings may be obtained only upon application to the Bureau of Ships, Navy Department, Washington 25, D. C. Both the title and identifying number or symbol should be stipulated when requesting copies.)

3. REQUIREMENTS

3.1 Material.- The minimum material requirements are as specified hereinafter. A good grade material shall be used when a definite material is not specified.

3.2 Type A instruction books.- Type A instruction books shall be as specified in the individual contract or order (see 6.1).

3.3 Type B instruction books.-

3.3.1 Contents.- Type B instruction books shall contain the following information as applicable, presented in a logical arrangement (see figs. 1 to 8, inclusive):

(a) Title page (see fig. 3).
(b) General data (see 3.3.1.1).
(c) Table of contents, listing all divisions and primary and secondary subdivisions (such as chapters, sections, etc.) with their corresponding page numbers.
(d) List of illustrations and plans, specifying titles, figure numbers and pages on which such illustrations appear.
(e) Introduction (see 3.3.1.2).
(f) Detailed description (see 3.3.1.3).
(g) Installation instructions (see 3.3.1.4).
(h) Adjustments and tests (see 3.3.1.5).
(i) Principles of operations (see 3.3.1.6).
(j) Operating instructions (see 3.3.1.7).
(k) Maintenance (see 3.3.1.8).
(l) Parts identification (see 3.3.1.9).
(m) Drawings (see 3.3.1.10 and 3.3.2.4.5.4).
(n) Memorandum pages (see 3.3.1.11).

NOTE: Although these requirements are directly applicable to instruction books covering specific equipment, they shall be followed as closely as possible for instruction books covering systems, such as engineering piping systems. When an instruction book covers a system or an equipment composed of several distinct units (for example, a generating set consisting of a diesel engine, a generator, a voltage regulator, and a controller), it may be desirable to arrange the book in major divisions, each covering one unit. If so, the major divisions may be arranged by sub-divisions, each corresponding to the requirements herein.

3.3.1.1 General data.- This division shall contain data such as the following:

(a) Safety notice (where high voltages or special hazards are involved).
(b) Component list containing:
    Description of item.
    Navy type designation.
    Navy or bureau or agency stock number (if available).
    Dimensions.
    Weight (with or without packing).
(c) Input power requirements and heat dissipation.
(d) Salient design characteristics.
(e) Electron tube complement.
(f) Serial number (if appropriate).

3.3.1.2 Introduction.- This division shall include a general description of the equipment, i.e., explain briefly what it is, where it is used, and what it will do, also all information of a general character applicable to the complete equipment. When the text contains technical terms or terms not commonly used, definitions shall be included.

3.3.1.3 Detailed description.- This division shall contain a complete detailed description of component assemblies and accessories which comprise the complete equipment; for example, in the case of a ship's service turbine generator set, the turbine, the gear, the generator, the exciter, and the voltage regulator. Allowable clearances, temperatures, tolerances, etc. shall be shown in tabular form.

3.3.1.4 Installation instructions.- This division shall contain methods of installation, alignment, precautions, mounting instructions, recommendations regarding shielding, grounding, bonding, etc.

3.3.1.5 Adjustment and tests.- This division shall contain instructions for the adjustment and test of the system and its major components upon initial installation or under other conditions such as after major overhaul where complete system readjustment may be required.

3.3.1.6 Principles of operation.- This division shall contain a brief resume of the principles of operation together with such illustrations, sketches, schematic piping diagrams and schematic wiring diagrams as convey an understanding of the function and operation of the equipment. Descriptions of components and assemblies using electron tubes should provide an explanation of the electronic circuits. A preferred method of describing electronic circuits is to present the description in sections, such as amplifier features, power circuits, main audio transmission path and mechanical arrangements. Theory of operation should be included where unusual or unconventional circuits or techniques are involved.

3.3.1.7 Operating instructions.- This division shall contain simple, brief and effective instructions, including normal routines and precautions to be observed in starting, operating, and shutting-down the equipment. Where operations are to be performed in specified sequence, step-by-step procedure shall be used. Operations shall be numbered in the order in which they are to be performed. Operating data which is frequently referred to in operating the equipment shall be included in this division. Tables and charts shall be used for the presentation of these instructions where varying operating conditions are encountered.

3.3.1.8 Maintenance instructions.-

3.3.1.8.1 Preventative maintenance.- This division shall cover all maintenance procedures, inspection and routine adjustments which should be performed periodically and regularly for the purpose of preventing failure or impairment of equipment. Included in this division shall be routine maintenance check charts containing the following:

(a) A tabulation of periodic routine mechanical and electrical tests and checks which should be accomplished regularly to insure continuity of service at peak performance.
(b) Arrangement of the table shall be such as to indicate what is to be done, when it is to be done and how to do it.
(c) Emphasis shall be placed upon the test facilities which may be incorporated in the various components.
(d) Instructions shall be provided for the care, inspection and cleaning of all pertinent parts.
(e) Instructions on lubrication shall be provided as applicable, preferably in chart form. They shall include information regarding lubrication recommended by the manufacturer, the type of lubricant to be used, together with specific time periods. Lubricants shall be described by Government specification numbers where applicable and by commercial designations.
(f) Instructions shall be included stressing the importance of properly maintaining any safety devices, interlocks, etc., provided to prevent damage to equipment or injury to personnel.

3.3.1.8.3 Corrective maintenance.- This division shall cover all information necessary to permit a technician to locate trouble and to make repairs or adjustments to each component, assembly or sub-assembly of the equipment. Included in this division shall be the following:

(a) Trouble shooting guides for the localization of faults giving possible sources of trouble, their symptoms, probable cause, and instructions for remedying the faults.

(b) Complete instructions on signal tracing for electron ane electronic circuits, use of test instruments and other common servicing techniques.

(c) Ample illustrations, photographs, exploded views giving details of mechanical assemblies, and simplified schematic diagram of the electric circuits. Illustrations, etc., contained in other divisions may be used and referred to under this division without duplicating them.

(d) Voltage and resistance diagrams or tables for each electronic assembly showing normal voltages (with and without audio signal) and resistances as measured at the terminals of each tube socket and at other significant points in the circuit.

3.3.1.9 Parts identification.- This division shall contain identification data covering all renewal parts (parts and/or assemblies which are wearable and/or expendable during normal repair) to facilitate ready identification of parts for replacement and ordering purposes. These data shall be presented in one of the three following alternate arrangements.

(a) Parts list and illustrations.- Where the instruction book does not include reduced size drawings which are prepared in accordance with the standard drawing format shown on Drawing 50103-73729, listing all renewal parts, the parts identification shall be in the form of a parts list with illustrations, arranged as specified in 3.3.1.9.1 and 3.3.1.9.2.

(b) Drawings and illustrations.- Where the instruction book includes reduced size drawings which are prepared in accordance with the standard drawing format shown on Drawing 50103-73729 (see fig. 5) listing all renewal parts, and where only mechanical parts are involved, the parts identification shall be in the form of illustrations to supplement the list of material on the drawings. Illustrations shall be prepared for each assembly, subassembly and their component renewal parts in accordance with 3.3.1.9.2 except that the index numbers shall be identical with the part numbers assigned on the above drawings. Appropriate notes shall be added to these illustrations referring to the drawings on which the assigned numbers are listed.

(c) Drawings, illustrations and functional listing.- Where the instruction book includes reduced size drawings which are prepared in accordance with the standard drawing formats shown on Drawing 50103-73729, and which list all renewal parts, and where electrical or electronic parts are involved, the parts identification shall be in the form of a functional listing of electrical and electronic parts with illustrations to supplement both the functional listing and the list of materials on the drawings. The functional listing of all electrical and electronic parts shall be prepared in accordance with 3.3.1.9.1.2. Illustrations shall be prepared for each assembly, subassembly and the component renewal parts thereof in accordance with 3.3.1.9.2, except that the index numbers shall be identical with the part numbers assigned on the above drawings (for mechanical parts) and with the reference designation assigned on the schematic wiring diagram (for electrical or electronic parts) appropriate notes shall be added to these illustrations referring to the drawings on which the assigned numbers are listed.

3.3.1.9.1 Parts list.-

3.3.1.9.1.1 Contents.- The parts list shall contain the following information:

(a) List of illustrations by figure and page number.
(b) Introduction.
(c) Parts tabulation.
(d) Special tools.
(e) Numerical index of part numbers.

3.3.1.9.1.2 Introduction.- This division shall contain sufficient instructions to explain the following:

(a) Any symbols used therein.
(b) The general system of group assemblies in relation to the complete article.
(c) All group-index systems employed.
(d) Titles or other markings intended to segregate different models.
(e) Other information as may be required to facilitate rapid and accurate use of the parts list.

3.3.1.9.1.3 Parts tabulation.- The parts tabulation shall contain the following information:

3.3.1.9.1.3.1 Tabulation for mechanical parts.-

(a) Figure number. This shall denote the illustration number wherein the part has been shown.
(b) Index number. This shall denote the index number covering the complete main or sub-assembly as listed in the catalog.
(c) Name of part and brief description.
(d) Number required.
(e) Unit of issue.
(f) Contractor's service part number.
(g) Actual manufacturer's name.
(h) Actual manufacturer's service part number.
(i) Standard Navy stock number (if available).

3.3.1.9.1.3.2 Tabulation for electrical and electronic parts.-

(a) Figure number. This shall denote the illustration number wherein the part has been shown.
(b) Reference designation assigned in the schematic wiring diagram.
(c) Name of part and brief description (including electrical ratings).
(d) Function. The function shall consist of a brief statement of use, purpose or the function of the part in the component.
(e) Joint Army-Navy Type Number (where applicable).
(f) Actual manufacturer's name.
(g) Actual manufacturer's service part number.
(h) Standard Navy Stock Number (if available).

3.3.1.9.1.4 Special tools.- This division shall contain a list of all special tools supplied with the equipment showing the quantity, unit of issue (i.e., each, pair, set, etc.), description, and manufacturer's identification number.

3.3.1.9.1.5 Numerical index of part numbers.- This index shall list all items contained in the parts tabulation, arranged in a logical numerical sequence. These items shall be so arranged that column 1 of the index will give the manufacturer's part number and column 2 will give the illustration index number or numbers in which the part appears.

3.3.1.9.2 Illustrations.- A view of each assembly, sub-assembly and the component parts thereof shall be shown. Identification of illustrated parts with the listed parts shall be facilitated by the use of key or index numbers which will identify all the parts in the group assembly listing.

3.3.1.9.2.1 Illustrations of the exploded type are preferable. When the use of exploded views is not practical, simple cross-sectional views may be used. The cross-sectional drawings when used for this purpose preferably shall be approved plans or excerpts from approved plans, and shall show both the manufacturer's drawing number and the plan number of the bureau or agency concerned. In case no applicable approved plan is available, cross-sectional views from manufacturer's drawings may be used.

3.3.1.9.2.2 A figure number and proper identifying caption shall appear with each illustration. In the case of subassemblies or sub-subassemblies, the caption shall also identify and give the index number of the complete assembly as it appears in the parts tabulation.

3.3.1.9.2.3 An index number with an arrow to the item, part, or tool to which it pertains shall be used in illustrations. In cases where an assembly is exploded into its component parts, one or more of which require further explosion, the primary explosion shall be referenced by the use of numerals only. The sub-assembly shall be referenced by the basic number of the part as it appears in the primary assembly but each exploded part shall have an alphabetical designation, suffixed to the number of the primary part. The sequence of numerical and alphabetical designations shall correspond to the order of removal upon disassembly, wherever practicable.

3.3.1.9.2.4 Index numbers and arrows shall be used on each illustration to identify renewal parts only.

3.3.1.10 Drawings.- This division shall contain reproductions of approved drawings, additional block diagrams, exploded views or explanatory drawings, as necessary to supplement the descriptive matter contained in the text. Wherever feasible, such diagrams, exploded views and sketches should be inserted in the text as close as possible to that portion of the text to which they apply. Diagrams of switches and relays used in the system showing the terminal numbering shall be inserted as additional drawings. The standard color codes for resistors and capacitors shall be printed, where applicable.

3.3.1.11 Memorandum pages.- Five blank pages shall be inserted at the end of the book for memorandum purposes.

3.3.2 Format.-

3.3.2.1 Divisions (chapters, sections, etc.).- Divisions of instruction books shall be by chapters or sections, numbered or lettered consecutively. In general, chapters shall be the main divisions of larger books and sections shall be the main division of smaller books. Chapters shall be further divided into sections which shall be numbered or lettered consecutively within the chapter. Where chapters are used, the first page of each chapter shall be arranged as shown on figure 3.

3.3.2.3 Page identification and numbering.-

3.3.2.3.1 At the top of each left-hand page, flush with the outside margin, shall appear a brief of title of the publication. At the top of each right-hand page, flush with the outside margin, shall appear the division, chapter, section, etc., number followed by its title. In some cases, it may be necessary to brief the title.

3.3.2.3.2 With the exception of fold-over pages and as otherwise specified, pages of the instruction books shall be numbered consecutively in the bottom outside corner of each page, using Arabic numerals. The first page of chapter 1 or section 1 shall be page 1. All odd-numbered pages shall appear as right-hand pages. Fold-over pages shall be right-hand pages, and when they are used within the text they shall be assigned two page numbers, and the numbers shall be printed on the face of the sheet. Fold-over arrangements are shown on figure 5.

3.3.2.3.3 In books arranged for a system or equipment composed of several distinct units (see note under 3.3.1) the pages may be consecutively numbered within each chapter (or section), the first page of each chapter (or section) being page 1. In this case, the page number shall also include the chapter number. The chapter number shall appear first.

3.3.2.4 Layout treatment.- The layout of instruction books shall be such as to conserve space without detracting from the usability or clarity of material presented. Blank pages and spaces shall be avoided wherever possible except as specified in 3.3.1.11. Textual material shall be printed on both sides of the page. Illustrations serving no instructional function or to which no reference is made in the text shall not be used. Partial page illustrations within the text are highly desirable. Several small illustrations may be grouped to form a single page layout. Wherever possible, illustrations shall be located so that reference can be made from applicable text without turning a page. Fold-over pages, combs, or triple pages will be permitted only for illustrations where this procedure is essential to insure legibility. Fold-over pages shall be used primarily in the back of the book for the purpose of reproducing the drawings. Whenever it is desirable to include fold-over pages with the text in the front of the book, such fold-over pages shall not be backed up with text or illustrations. All drawings which will be used for reference purposes while reading the text shall be provided with a blank section of the same size as a page at the left hand edge of the drawing (see fig. 5). This will permit the drawing to be withdrawn clear of the book while the text is being studied. Drawings shall be reproduced on a page the same height as other pages in the book, in order that all folds will be parallel to the bound edge of the book.

3.3.2.4 Text.-

3.3.2.4.1 Tables and charts.- The use of tables and charts is desirable. Such tables and charts shall not be elaborate or complicated, and sufficient explanation shall be given to make them easily understood.

3.3.2.4.2 Reference to figures.- Where reference is made to figures, the reference shall be to the figure number. The page number shall not be used except when the illustration is located more than three pages away from the reference. When reference is made to items shown on figures by index numbers, figure number and index number shall be indicated as follows: "Remove nut (7) and drive out bolt (8), (See fig. 20)."

3.3.2.4.3 Numbers.- Numbers from one to nine, inclusive, appearing in the text for the purpose of stating quantities shall be spelled out. All other numbers shall be shown as numerals except when they are used at the beginning of a sentence, in which case they shall be spelled out and followed by the numeral in parenthesis.

3.3.2.4.4 Reference to materials.- All materials required for maintenance referred to in the instruction book, such as lubricants, sealing materials, abrasives, etc., shall be described by specification numbers where applicable.

3.3.2.4.5 Illustrations.- Illustrations (including photographs, exploded views, drawings and sketches) shall be well planned and executed. They shall enable immediate and thorough comprehension of the subject.

3.3.2.4.5.1 Illustration identification.- Illustrations shall be identified by figure number and a title. Identifying figure numbers and titles shall be positioned immediately beneath the illustration. Whenever reduced size reproductions of drawings are used as illustrations, the drawing number shall be shown as well as the figure number.

3.3.2.4.5.2 Photographs.- Photographic illustrations shall be prepared with equipment capable of reproducing all details and shall show clearly the subject matter. Photographs shall be uniformly retouched to define shapes, accentuate details and establish correct tone value of sufficient contrast for photolithographic reproduction.

3.3.2.4.5.3 Exploded views.- Exploded views are desirable for showing the component parts of a subject. Well retouched photographs in which sharp contrast is incorporated to insure distinct detailed separation of parts may also be used for this purpose. It is preferable that all parts be exploded on their functional axis.

3.3.2.4.5.4 Drawings.- When drawings are necessary to illustrate the description, operation, and maintenance of the equipment or system, they shall be reduced in size as necessary (see fig. 5), and reproduced in black and white. Each drawing shall be identified with the drawing number of the manufacturer and the bureau or agency concerned. Drawings shall be bound into the instruction book as shown on figure 6 (see also 3.3.2.3). Drawings shall normally be placed in the back of the manual but they may be inserted close to the references when practicable. Care shall be taken in the preparation of drawings for reproduction in the instruction book to insure that when the drawings are reduced in size they shall be clear and legible.

3.3.2.4.5.5 Sketches (see fig. 6).- (NOTE: This paragraph does not pertain to reduced-size reproduction of standard approved drawings nor to portions of these drawings which may be extracted and used as illustrations in a book.)

3.3.2.4.5.5.1 The rendering of sketches (airbrushing or line rendering) shall be done with the highest possible contrast. Adjoining areas of an illustration having similar values are to be avoided. Edges of all silhouette half-tone illustrations shall be sharply defined by retouching.

3.3.2.4.5.5.2 Exploded views and cutaway views shall be drawn in perspective to appear as realistic as possible without distortion. Isometric views may be used for small parts or units which lend themselves to this method without showing noticeable distortion.

3.3.2.4.5.5.3 Except for diagrams, schematics, orthographic projections, reproductions of approved drawings, etc., all line sketches shall be prepared with the use of shading mediums to clarify and model the form of the sketch. This rendering shall be kept as simple as possible. Fuzzy freehand lines, rendering with fine lines, and cross hatching shall be avoided. Solid black shall be used in dark areas to increase contrast and simplify the sketch. This applies to cutaway views, exploded views and cross-section views.

3.3.2.4.5.6 Color.- Color shall be used functionally where necessary to show electric circuits, the flow of materials, schematic diagrams, operational diagrams, etc. Unessential color shall not be used. Backgrounds of color tints may be used to clarify outline sketches, but color for decoration is not desired.

3.3.2.4.6 Indexing and referencing of illustrations.-

3.3.2.4.6.1 Significant features or components of illustrations shall be identified by brief applicable nomenclature with arrows. Index numbers may be used on illustrations with explanatory legend under the sketch or photo only when an extremely large amount of nomenclature is required.

3.3.2.4.6.2 In order to assure a clear definition of lines where they pass through light and dark areas, arrows (leaders) shall be drawn in black with one edge outlined in white. The arrowheads, however, shall be completely outlined in white. The thickness of arrows shall be uniform and no greater than necessary to indicate clearly the desired details.

3.3.2.4.6.3 Index references and letterings (nomenclature) shall be planned to reproduce uniformly a size not less than 10-point type. Where index numbers are used, each illustration shall be handled independently with index numbers assigned consecutively, starting with number 1, except as specified in 3.3.1.9(b), 3.3.1.9(c), and 3.3.1.9.2.3.

3.3.2.4.7 Printing.- Printing shall be done by either offset, lithograph or letterpress method, and shall be of equal quality to first-class commercial work. Copy may be type-set, varityped, or typewritten with a standard typewriter. In general, type-set copy is preferred with varityped or type copy as second choice. The style of composition to be used, however, shall be governed by the quantity of books to be produced, the relative costs of the several methods, the availability of material prepared for earlier books, etc., The contractor shall specify the method of composition to be used when manuscripts or sample copies are submitted for approval. The bureau concerned may request data from the contractor to substantiate the method of composition entered if deemed desirable.

3.3.2.4.7.1 Arrangement.- The text may be arranged in the form of either two vertical columns or a single wide column. The two-column arrangement shown on figures 4 and 7 is preferred; the single column arrangement is shown on figure 8. Right-hand margins shall not necessarily have lines flush at right, but care shall be taken to prepare a generally uniform margin. The size of the page shall be 8-1/2 by 11 inches. Text shall be reproduced on both sides of paper.

3.3.2.5 Paper.- The paper (or photolithographic reproduction shall on preferably 35 by 38-80/500-basis litho-finish; for letterpress 35 by 38-70/500-basis dull-finish enamel stock.

3.3.2.6 Covers.- Covers for books less than 1/2 inch thick (less cover) shall be of the self-wrap fold type and of a black fabrikoid material. Covers for books over 1/2 inch in thickness shall be made of semiflexible board covered with a black fabrikoid material, weight 6-1/2 to 7-1/2 ounces per square yard (finished cloth). The covers shall be imprinted in gold, silver or aluminum color with the information shown on figure 4. Backbones of books over 1/2 inch in thickness shall be imprinted with the Navy identification (NAVSHIPS) number (see 3.3.3.2) and title in brief.

3.3.2.7 Binding.-

3.3.2.7.1 The binding shall be looseleaf using three 3/16-inch metal posts and screws, spaced on 4-1/4 inch centers. Covers for books 1/2 inch thick or more shall have a binding flange of corrosion-resisting metal covered with 700 quality fabrikoid. On books containing less than 26 pages (25 sheets), split-type metallic fasteners with metallic washers may be used. All metal parts shall be of corrosion-resisting material, or shall be treated to resist corrosion. Under the condition that parts list (see 3.3.1.9.1) and/or the instruction book is of such thickness that the addition of the parts list would make the final book contain over 400 pages, the parts list shall be bound in a separate volume with appropriate reference on each volume as to the content of the other volume.

3.3.2.7.3 Overlay.- Covers shall slightly overlap the top, bottom, and right-hand edges of the book by approximately 3/16 inch. Outside corners of covers shall be slightly rounded.

3.3.2.8 Identification.- All books shall be identified by a Navy identification number of the form "NAVSHIPS 3[illegible]-1[illegible]" (see figs. 1 and 2). This number will be assigned by the bureau or agency concerned upon receipt of the copy submitted for bureau or agency approval. In urgent cases, this number may be obtained by a written request, containing complete descriptive data of the equipment. This number shall be imprinted on the upper left-hand corner of the cover and upper-right hand corner of the fly-leaf of all books prior to distribution.

3.3.3 Copyright.- Instruction books shall not be copyrighted. The bureau or agency concerned reserves the right to reproduce or have reproduced in part or in entirety all instruction books procured under this specification.

3.3.4 Security classification.- Unless otherwise specified, instruction books shall be unclassified. If restricted, confidential or secret, notification of this classification shall appear on the front and back covers and each page of the books as shown on figures 1 to 6, inclusive. Confidential and secret instruction books shall be marked with consecutive serial numbers beginning with number 1. Classified instruction books shall be prepared in accordance with the Navy Handbook Security Measures for the Protection of Classified Printed Matter During Production (NAVEXOS P-29). Particular care shall be exercised to insure the security of classified matter during the preparation. Receipt cards shall be provided in all confidential and secret books. Each card shall contain the serial number of the book in which it is included.

3.3.5 Method of approval.- Prior to printing of final instruction books, a complete text including a list of all illustrations (photographs, exploded views, drawings and sketches) shall be prepared and submitted in duplicate to the bureau or agency concerned via the Government inspector for approval and assignment of Navy identification (NAVSHIPS) number (see 3.3.2.8). Every effort shall be made to submit this material in ample time to permit approval and printing prior to the delivery date of the equipment.

3.3.6 Revision to incorporate changes.- The contractor will be required to furnish new and or revised pages covering all changes until the guarantee period expires. The quantity of pages furnished shall be the same as the quantity of the applicable instruction books furnished under the contract or order. New pages shall be identified with the following legend placed beside the page number and toward the binding edge of the page; on the first line, the word "New" followed by the publication identification number; and on the second line the month and year of issue. A similar procedure shall be followed for revised pages except the word "Revised" shall be substituted for the word "New".

3.3.7 Time of delivery.- Unless otherwise specified, instruction books shall be delivered with the first unit of equipment shipped. If final instruction books are not available at the time of delivery of the equipment, two copies of an adequate preliminary instruction book (see 3.3.8) shall be furnished to the Government inspector for shipment with each unit. In all cases where preliminary books are furnished they shall be replaced with final books within 60 days.

3.3.8 Preliminary instruction books.-

3.3.8.1 General.- If it appears impossible to produce final instruction books by the time the first production equipment is ready for delivery, the contractor shall request authority of the bureau or agency concerned to furnish preliminary instruction books.

3.3.8.2 Method of approval.- The procedure described in 3.3.5 shall be followed for approval of preliminary instruction books, if the final book has not been approved.

3.3.8.3 Printing.- The text may be printed by any quick, economical method, such as multigraph, mimeograph or similar method.

3.3.8.4 Contents.-

3.3.8.5 Text.- Preliminary instruction books shall include the complete text as it is submitted to the bureau or agency concerned for approval of final instruction books.

3.3.8.6 Illustrations.- Preliminary instruction books shall contain a complete list of the illustrations which will appear in the final book. If the final book is to include data, or a table of weights, for example, and if any or all of the items are not available when the preliminary book is issued, blank foreword shall list all items which have been omitted and which will appear in the final book.

3.3.8.7 Book identification.- Book identification number shall be stamped on all copies of preliminary instruction books prior to distribution (see 3.3.2.8).

3.3.8.8 Covers.- Covers for preliminary books shall be at least 20 by 26-65/100-basis gray antique finish cover stock or similar material, bellows fold, with the title and other pertinent information on the cover. This information shall be identical with that which will appear on the final book except that the word "preliminary" shall appear directly in front of the identification number (see 3.3.2.8).

3.4 Type C instruction books.-

3.4.1 Contents.- Type C instruction books shall conform to 3.0 except that 3.3.1.2, 3.3.1.6, 3.3.1.8, 3.3.1.9, 3.3.1.11 and 3.3.2.4.5.6 shall not apply. Additional requirements are specified in 3.4.2 and 3.4.3.

3.4.2 Maintenance.-

3.4.2.1 This division shall cover all maintenance procedures and routine adjustments which should be performed periodically, as well as instructions for dismantling and replacement of worn or damaged parts. Instructions on lubrication shall be provided as applicable, preferably in chart form, and shall include the type of lubrication recommended by the manufacturer, together with specific time period. Lubricants shall be described by Government specification numbers, where applicable, and by commercial designations.

3.4.2.2 Special tools.- Maintenance instructions shall cover the use of special tools.

3.4.3 Parts identification.- This division shall contain identification data covering all renewal parts (parts and/or assemblies which are wearable and/or expendable during normal repair) to facilitate ready identification of parts for replacement and ordering purposes.

3.4.3.1 Parts list.- Parts shall be listed as follows:

(a) Name of part.
(b) Number required.
(c) Actual manufacturer's name and service part number.
(d) Standard Navy Stock Number if available.

3.4.2.3 Parts illustrations.- A view of each assembly or subassembly or component parts shall be shown. Identification of illustrated parts shall be facilitated by the use of numbers which will identify all the parts in the parts list. Illustrations of the exploded type are preferable. When the use of exploded views is not practical, simple cross-sectional views may be used. The cross-sectional drawings when used for this purpose preferably shall be approved drawings or excerpts from approved drawings, and shall show both the manufacturer's drawing number and the drawing number of the bureau or agency concerned. In case no applicable approved drawing is available, cross-sectional views from manufacturer's drawings may be used.

3.5 Type D instruction books.-

3.5.1 Contents.- Type D instruction books shall consist of manufacturer's standard commercial instructions and parts lists bound together.

3.5.2 Format.-

3.5.2.1 Covers.- Covers shall be of a dark color impregnated paper similar to Dupont "Fabkote" 3-35 back coated. The cover shall show name and model of the equipment, manufacturer's name and address, Navy contract or order number and Navy identification (NAVSHIPS) number. Printing shall be of a light contrasting color. Covers shall be 8-1/2 by 11 inches for all books of that size or smaller.

3.5.2.2 Binding.- The books and covers shall be bound either by stapling, stitching or by use of metal binding posts.

3.5.2.3 The requirements specified in 3.3.2.5, 3.3.3, 3.3.4, 3.3.5, and 3.3.7 shall apply.

3.5.2.4 Method of approval.- Sample books shall be submitted in duplicate to the bureau or agency concerned via the Government inspector for approval and assignment of an identification (NAVSHIPS) number (see 3.3.2.6). Every effort shall be made to submit this material in ample time to permit approval prior to delivery date of the equipment.

3.6 Workmanship.- The workmanship shall be of high quality comparable in text compilation, arrangement, and accuracy to high-grade commercial instruction books and parts catalogs. Copy which has filled letters or is blurred will not be acceptable. The workmanship shall be satisfactory to the bureau or agency concerned.

4. SAMPLING, INSPECTION AND TEST PROCEDURES

4.1 The methods of approval are specified in section 3.

5. PREPARATION FOR DELIVERY

5.1 Packaging.-

5.1.1 For domestic shipment.- Commercial packaging will be acceptable.

5.1.2 For overseas shipment.- Instruction books shall be individually packaged and sealed in waterproof envelopes or wrapped and sealed in waterproof paper, the material of which shall conform to types C-1, E-1 or better of Specification JAN-P-126. The seams and closures of envelopes and wrappers shall be sealed with adhesive conforming to Specification JAN-P-140. Care shall be exercised in the use of papers having a lamination of asphaltum to prevent a deleterious effect on the books.

5.2 Packing.-

5.2.1 For domestic shipment.- The subject commodity, packaged as specified in 5.1.1 shall be packed in cleated plywood boxes, nailed wood boxes, or wirebound boxes conforming to Specifications JAN-P-105, JAN-P-108 and JAN-B-107, respectively, or in suitable-style corrugated or solid fiberboard boxes conforming to the following requirements:

Maximum gross weight	Minimum average bursting strength	Maximum sum of inside dimensions
Pounds	Pounds	Inches
40	200	80
65	275	75

Bottom flaps of fiberboard shall be sealed by means of a suitable adhesive or metal-stitched. Top flaps shall be sealed, stitched, or taped, or closed by a combination of these methods. If taped, kraft gummed tape of not less than 2-1/2-inch width, 60 pound minimum basis weight shall be used. Each shipping container shall be lined with a sealed waterproof bag made of material conforming to Specification JAN-P-135. The seams and closures shall be sealed with adhesive conforming to Specification JAN-P-140. The gross weight of boxes of wood construction shall not exceed approximately 150 pounds.

5.2.2 For overseas shipment.- The subject commodity, packaged as specified in 5.1.2, shall be packed in cleated plywood boxes or nailed wood boxes, conforming to Specifications JAN-P-105 and JAN-P-108, respectively. The gross weight shall not exceed approximately 150 pounds.

5.3 Marking.- In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with the Navy Shipment Marking Handbook.

6. NOTES

6.1 Ordering data.- Requests, requisitions, schedules, and contracts or orders should specify the following:

(a) Title, number and date of this specification.
(b) Type of instruction book required (see 1.1).
(c) Requirements for type A (see 3.2).
(d) Details of special requirements for plans, charts, illustrations, etc., pertinent to the particular equipment, if not covered by the equipment specification.
(e) Security classification, if required (see 3.3.4).
(f) Whether the books are to be packed and marked for domestic or overseas shipment (see 5.2 and 5.3).
(g) Quantity of instruction books required (see 6.2).

6.2 Instruction books for stock should be specified generally in the following quantities:

Number of equipments	Number of copies
1 to 5	25
6 to 25	25 plus 2 per equipment
26 to 950	50 plus 2 per equipment
Over 950	1000

Bulk copies of books furnished for stock should be shipped to:

Commanding Officer
Ships Parts Control Center
Naval Supply Depot
Stock Control Department
Mechanicsburg, Pennsylvania

6.3 Copies of this specification may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C., except that activities of the Armed Forces should make application to the Commanding Officer, Naval Supply Center, Norfolk 11, Va. Both the title and identifying number or symbol should be stipulated when requesting copies.

Notice.- When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

FIGURE 1 - TYPICAL COVER

BUREAU OR AGENCY IDENTIFICATION AND NUMBER OF PUBLICATION appears in upper left-hand corner, set in 18pt. Stymie light caps with Stymie bold numerals.

SECURITY CLASSIFICATION (See 3.3.4) appears in upper right-hand corner, set in 18 pt. Stymie light caps. (Security Classification in this case is "Restricted".)

TYPE OF BOOK set in 24 pt. Stymie extra bold upper and lower case.

SPECIFIC TITLE OF BOOK set in 30 pt. Stymie extra bold caps.

MANUFACTURER'S NAME AND ADDRESS

MANUFACTURER'S CONTRACT NUMBER TO be set under Manufacturer's name as shown, in 18 pt. Stymie light, upper and lower case.

MANUFACTURER'S BOOK NUMBER OR IDENTIFICATION

NAME OF BUREAU, NAVY DEPARTMENT, WASHINGTON, D.C., to be set at bottom of page in 12 pt. Stymie light caps, letter spaced and separated as shown.

SECURITY CLASSIFICATION (See 3.3.4) appears in lower left-hand corner, set in 18 pt. Stymie light caps. (Security Classification in this case is "Restricted".)

NOTE - If Stymie is not available, the following faces may be substituted in this order: Beton, Girder, Futura and Kabel. Weights shown shall be maintained.

ADVANCE COPY

MIL-M-15071D(SHIPS)
SUPERSEDING
MIL-M-15071C(SHIPS)
10 September 1957

MILITARY SPECIFICATION

MANUAL, SERVICE (INSTRUCTION BOOKS) FOR SHIPBOARD ELECTRICAL AND MECHANICAL EQUIPMENT

1. SCOPE

1.1 Scope. - This specification sets forth Bureau of Ships requirements for classes and general contents of manuals necessary for the satisfactory operation, maintenance, installation, overhaul and repair, without the services of manufacturer's representative, of electrical, mechanical, hull, interior communication and fire control shipboard equipment. This specification also includes procedures for submission, review, approval and revision of the service manual. The intent is to secure for manufacturers commercial type manual or one prepared in accordance with his commercial practice whenever it is brought equivalent to the general requirements listed herein.

1.2 Classification. - Service manuals shall be of the following classes:

Class A manual - A basic manual covering a family of equipment of the same basic design and one which can be made applicable to a specific equipment manufactured to that basic design by completing sheets and blanks.

Class B manual - A manual covering a specific equipment for which a class A approval has not been obtained.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-D-985 - Drawing, Electrical, Hull and Mechanical Equipment for Naval Shipboard Use.

FSC 7610

PLAINTIFF'S EXHIBIT A

MIL-M-15071B(SHIPS)

PUBLICATIONS

DEPARTMENT OF DEFENSE
DD Form 441 (Attachment) - Industrial Security Manual for Safeguarding Classified Information.

(Copies of specifications and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

OFFICIAL CLASSIFICATION COMMITTEE
Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, N. Y.)

3. REQUIREMENTS

3.1 Media for final manuals and approval.

3.1.1 Class A manuals. - Whenever a manufacturer's equipment lends itself to the preparation of a manual covering a family of equipments of the same basic design and one which can be made applicable to specific equipments of that design by completing the cuts and blanks, the manufacturer may submit to the Bureau of Ships four copies of the basic manual together with examples of the cuts and blanks which will represent the detailed information to be provided for a specific equipment. Approval of a class A manual will be by the Bureau of Ships only and, when approved, the basic manual shall not be modified without the approval of the Bureau of Ships. At the time of class A manual approval, the Bureau will assign a NAVSHIPS number to the basic manual and forward one copy to the cognizant inspector for future completion inspection with manuals furnished for specific equipments.

3.1.1.1 Once approval of a class A manual is granted for a particular basic design of equipment (and size-range, if appropriate), the basic manual with the specific detailed information required for the unit of the family being furnished on a contract or order may be supplied by the manufacturer, in the quantities required by that order, without further approval. Copies of the manual prepared for the specific equipments shall be marked by the manufacturer with the NAVSHIPS number of the basic manual followed by "-1", "-2" or higher. Each dash number shall be assigned numerically by the manufacturer for each specific equipment of that family.

3.1.2 Class B manuals. - Class B manuals cover a specific equipment for which class A approval has not been obtained. Once a class B manual has been approved by the Bureau or its field representative, the manual shall not be modified without approval of the Bureau of Ships. (NOTE: Bureau of Ships field representative - Where the term "field representative" is used in this specification, it is limited to field representative of the Bureau of Ships, i.e. Supervisors of Shipbuilding, USN, U.S. Naval Shipyards and Industrial Managers, USN.) Whenever a manual for a specific equipment has not been approved previously, for this or a previous issue of this specification, prior to preparing final manuals, the manufacturer shall prepare and submit a sample manual for approval to one of the following activities, as appropriate:

(a) Manuals procured on Bureau of Ships contracts - Contractor shall forward four sample copies to the Bureau of Ships for approval and assignment of a NAVSHIPS number with a copy of the forwarding document to the cognizant Government inspector.

(b) Manuals procured on contracts issued by Naval activities other than Bureau of Ships - Contractor shall forward four sample copies to the Naval activity for approval.

(c) Manuals procured for the Navy by a commercial activity (such as a private shipbuilder) - Contractor shall forward five sample copies to the commercial activity for approval of both the commercial activity and the cognizant Bureau representative.

3.1.2.1 The Bureau will assign a NAVSHIPS number to each different class B manual as follows:

(a) Manuals procured on contracts issued by the Bureau of Ships - The NAVSHIPS number will be included in the approval letter.

(b) Manuals procured on contracts issued by other activities.

NAVSHIPS 0967-LP-358-7710

The field approving activities may obtain NAVSHIPS numbers from the Bureau of Ships by use of the following methods:

(a) Submit two copies of the manual prior or subsequent to the review and approval.

(b) Permit the manufacturer to forward two copies of the manual to the Bureau simultaneously with the copies for approval.

(c) In urgent cases, submit a letter containing the nameplate data of the equipment, the ship applicability and contract or order number.

5.1.2.2 Regardless of the method used for obtaining NAVSHIPS numbers, the letter request shall state the expected delivery date of the manuals and the quantity of manuals being furnished for each.

5.1.3 Standards. - The Bureau of Ships is mainly interested in the adequacy and completeness of contents and the clarity and readability of the information rather than the format. The manual shall be oriented toward operation, maintenance and repair of the equipment by the forces afloat, without the services of a manufacturer's representative. The portions devoted to descriptive matter and theory shall be limited to those which are essential to a proper understanding of the equipment for satisfactory operation, maintenance and repair. The text need not duplicate information which is adequately shown on the photographs, drawings and illustrations incorporated in the manual. (A class A or B manual may be the manufacturer's commercial manual, or one prepared in accordance with his commercial practice whenever it will be suitable for the service intended as determined by the approving activity.)

5.1.4 Security classification. - The security classification of manuals shall be as designated by the bureau or agency concerned. If classified, the security guide issued by DD form 254, forming a part of the contract shall be followed. All pages shall be marked in accordance with the requirements of the Industrial Security Manual for Safeguarding Classified Information (DD 441 [Attachment]). Where a minor amount of classified information is involved, two volumes - one unclassified and one classified shall be provided. The word "UNCLASSIFIED" need not appear on each page of unclassified portions of classified manuals. Revisions shall be classified as required by their subject matter. Regardless of the overall classification of a classified publication, an unclassified title shall be assigned whenever possible and consistent with security and clarity. In all cases, however, if a classified manual is involved, the initials of the classification assigned to the title, standing alone, shall be indicated in parentheses immediately following the title, using one of the following notation (U), (C), (S), (TS). In addition, the covers of classified manuals shall include the markings as indicated on figure 1.

3.1.5 Detail requirements. -

3.1.5.1 Contents. - Manuals shall contain the following information, arranged in an order appropriate to provide adequate instruction for operation and maintenance of each unit in the equipment and the complete assembly. No particular arrangement, format or chapter titles are required as long as the information is suitably presented.

Front Matter
General Information
Installation
Principles of Operation
Operating Instructions
Maintenance and Repair
Parts Lists

3.1.5.2 Front matter. - The front matter shall consist of the following:

(a) Cover
(b) Title page (for classified manuals only)
(c) Approval and procurement record page
(d) List of effective pages
(e) Table of contents
(f) List of figures
(g) List of tables

3.1.5.2.1 Cover and title page. - The cover shall contain the information on figure 1. The title page for classified manuals shall conform to figure 2.

3.1.5.2.2 Approval and procurement record page. - The approval and procurement record (APR) page shall be the first page of unclassified manuals and shall follow the title page of classified manuals and shall conform to figure 3.

3.1.5.2.3 List of effective pages. - A list of effective pages shall be included. In multiple volume manuals, the list of effective pages shall be included in volume 1 only. The list of effective pages shall be modified whenever revisions are incorporated in copies of the manual.

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3.1.5.2.4 Table of contents. - The table of contents shall list all primary divisions and secondary subdivisions such as chapters, sections and pages with their corresponding numbers. Where sub-manufacturers are furnishing associated equipment and a separate manual is not provided, it shall be the responsibility of the prime contractor to integrate and reflect the information provided by the sub-manufacturers within the table of contents. In multiple volume publications, a table of contents shall be prepared for each volume.

3.1.5.2.5 List of figures. - A list of figures shall be prepared listing all figures, their titles and numbers. In multi-volume publications, a list of figures shall be prepared for each volume.

3.1.5.2.6 List of tables. - A list of tables shall be prepared listing all tables, their titles and numbers. In multi-volume publications, a list of tables shall be prepared for each volume.

3.1.6 General information. - General information shall consist of general data, a general description and detailed descriptions, as necessary to supplement data included in drawings and photographs.

3.1.6.1 General data. - General data shall consist of the following data for each equipment unit:

(a) Descriptive (name plate) data necessary to identify manufacturer, type, model and performance or design characteristics.
(b) Principal overall dimensions.
(c) Weight.
(d) Allowable capacities, temperatures, pressures, settings, tolerances or other salient factors as appropriate. In addition shall be given.

3.1.6.2 General description. - General description shall consist of a short general description of the equipment, explain briefly what it is, what it will do, include general overall and interrelated operation of the various units. All information of a general character applicable to the complete equipment shall also be given. Where the text contains terms or symbols not commonly used, definitions or explanatory notes shall be included.

3.1.6.3 Detailed description. - Detailed description shall contain a complete detailed description of units and assemblies which comprise the complete equipment; for example: ship service turbo generator, the turbine, reduction gear, generator and cruiser.

3.1.7 Installation. - Instructions, if necessary to supplement the installation drawings supplied (in accordance with Specification MIL-D-963), shall consist of methods of installation, including packing or unpacking, handling, preparation of foundation, alignment, precautions, mounting instructions, bolting diagrams, safety guards, grounding or bonding, clearances for access, ventilation, motion under shock, and methods of testing to assure satisfactory installation.

3.1.8 Principles of operation. - Figures, sketches, performance curves, and schematic wiring diagrams shall be included to the extent necessary to provide satisfactory operation, maintenance and repair. Operating sequences of automatic and semi-automatic equipment shall be indicated.

3.1.9 Operating instructions. - Instructions shall include routine and emergency procedures, including precautions, maximum and minimum loads, normal temperatures or pressure limits or both, transfer from manual to automatic operation (or the reverse), to be observed in the starting, operating, stopping, and shutting down of the equipment. In addition, action(s) which should be taken in the event of power failure; control air failure; lube-oil failure; partial failure of equipment; and similar conditions shall be described. Action(s) described in the event of partial failure shall include, where practicable, those procedures necessary to provide continued service of the equipment until time is available to repair the equipment. Where operating procedures are to be performed in specific sequence, step-by-step procedures shall be given. Operations shall be numbered in the order in which they are performed. Tables and charts shall be used for the presentation of these instructions where varying operating conditions are encountered.

3.1.10 Maintenance and repair. -

3.1.10.1 Preventive maintenance. - Instructions shall include all maintenance procedures, inspections, tests, and adjustments which should be performed periodically under shipboard conditions for the purpose of preventing failure or impairment of the equipment. A one page summary and time schedule for maintenance procedures, including a check-off table where appropriate, shall be provided. The summary sheet shall identify any items required by the Navy, not initiated at time of approval action, to be included in the ship's permanent history cards. Where necessary instructions shall include procedures for obtaining access to the sub-components for maintenance. Maintenance instructions shall include, where appropriate, but shall not be limited to the following:

(a) A combination of periodic, routine, mechanical, and electrical tests and checks which should be accomplished regularly to show that sub-components are operating properly and to insure continuity of service at optimum performance.

(b) Table or charts, including "wear-limit" charts when appropriate, to indicate what is to be done, when it is to be done based on inspection, and how to do it.

(c) Illustration of the test facilities which may be incorporated in the various components.

(d) Instructions for the care, inspection, and cleaning of all pertinent parts.

(e) Instructions stressing the importance of properly maintaining all safety devices and interlocks provided to prevent damage to equipment or injury to personnel.

(f) Instructions on lubrication at shipboard operating temperatures shall be provided as applicable, preferably in chart form. They shall include information regarding lubrication recommended by the manufacturer and the type of lubricant to be used. Lubricants shall be described by symbol number, Federal stock number, Military specification and commercial numbers where applicable and known.

(g) Instructions on in-place balancing or other means of reducing noise level if equipment specifications and shipboard application require quiet operation.

5.1.16.2 Trouble shooting, overhaul and repair. - Instructions shall include all information necessary to permit a technician to locate trouble, and to make repairs, adjustments and remove parts of each component, assembly or sub-assembly of the equipment. The following shall be included:

(a) Trouble shooting guides for the localization of faults giving possible sources of trouble, the symptoms, probable cause, and instructions for remedying the faults.

(b) Complete instructions on signal tracing for electric circuits, use of special test instruments and unusual servicing techniques;

(c) Ample figures and sectional views giving details of mechanical assemblies, and simplified schematic diagrams of electrical, mechanical, hydraulic and pneumatic circuits. Figures contained elsewhere in the manual may be used and referred to under this heading without duplicating them.

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3.3 Text.

3.3.1 Wording. - The text shall be factual, specific, concise, and clearly worded to be readily understandable by personnel involved in the operation, repair, overhaul and maintenance of the equipment, and to provide sufficient information for technicians to install, operate, service, and maintain the equipment at peak performance without the services of a manufacturer's representative. Technical phraseology requiring a special-ized knowledge shall be avoided except where no other wording will convey the intended meaning, in which case the technical term shall be defined.

3.3.2 Level of writing. - As a general guide, the level of writing should be that for a high school graduate having specialized training as a technician through navy training courses.

3.3.3 Figures. - Sectional views of assemblies, sub-assemblies and the component parts thereof shall be shown as necessary to supplement the text, photographs, and drawings and aid in the identification of parts. Identification of illustrated parts with listed parts shall be facilitated by the use of index (or piece) numbers and arrows which will identify assemblies, sub-assemblies and component parts thereof.

3.3.4 Indexing and referencing of figures. - Significant features or components of figures shall be identified by metal applicable nomenclature with arrows. Index (or piece) numbers may be used on figures when an extraordinarily large amount of nomenclature is required.

3.3.5 Deleted figures. - When a change requires deletion of a figure without substitution of another, the following sentence shall be inserted "Figure ____ deleted" in or near the place of deletion.

3.3.6 Cautions, warnings and notes. - Notes, cautions and warnings shall be used only to emphasize operating procedures, conditions, etc., essential to safety and shall be selected in accordance with the following definitions:

(a) Note. - An operating procedure, condition, etc., which it is essential to highlight.

(b) Caution. - Operating procedure, practice, etc., which, if not correctly performed or adhered to, could result in damage or destruction of equipment.

(c) Warning. - Operating procedures, practices, etc., which, if not correctly followed, could result in personnel injury or loss of life.

3.4 Applicability of manuals: -

3.4.1 Identical. - When a class A manual covering a specific equipment or a class B manual which is already available, is applicable in the entirety to the equipment being procured, the applicability is to be extended to include the additional ships by the manufacturer issuing an approval and procurement record page. Copies of the manual required for the ship(s) and local use may be requisitioned from stock by the cognizant Naval supervising activity.

3.4.2 Identical except for minor modifications. - When a class A manual covering a specific equipment or a class B manual is applicable to the equipment being procured except for minor differences, the manufacturer shall modify the manual to cover the differences by the issue of revised or supplementary pages. All revisions to an existing manual shall be approved by the Bureau of Ships, shall require the assignment of a change number, assigned by the Bureau of Ships, and shall be issued by the manufacturer with an approval and procurement record page.

3.5 Revisions. - Revisions to manuals which have been previously distributed shall be prepared as follows:

(a) New pages - New pages shall be issued when it is found necessary to include new information to augment the content of the original manual.

(b) Revised pages - Revised pages shall be issued to make changes which apply uniformly to all equipments covered by the manual.

(c) Supplementary pages - Supplementary pages shall be issued when necessary to provide alternate instructions applicable only to a portion of the total equipments covered by the manual because of minor modifications or minor differences in related components.

3.5.1 Legend for revisions. - All new, revised or supplementary pages shall include the words "new", "revised" or "supplementary", the date and a change number.

3.5.2 Submission for approval. - Four copies of each revision shall be submitted to the Bureau for approval and assignment of a change number. The forwarding letter shall include the number of stock copies and the estimated delivery date of the final copies.

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3.6 Production requirements. —Detail materials, printing procedures and assembly for each manual shall be as approved at time of class A or B manual approval. An acceptable arrangement is set forth in the appendix of this specification. Alternate arrangements will be approved if equivalent performance is provided.

3.7 Distribution requirements. - Unless otherwise specified in the contract or order, distribution of all manuals not exactly identical to one previously procured and assigned a NAVSHIPS number shall be as follows:

(a) Two copies for each equipment shall be packed with the equipment when the equipment is shipped to stock.
(b) Two copies for each equipment shall be shipped separately to the cognizant Naval supervising activity marked for each ship on which the equipment is to be installed.
(c) Two copies to the Bureau of Ships.
(d) Three copies to the cognizant Supervisor of Shipbuilding when the equipment is to be installed by a private shipyard. (These copies are in addition to the copies for placement on board the ship.)
(e) Two copies to the Naval Shipyard when the equipment is to be installed by that activity. (These copies are in addition to the copies for placement on board the ship.)
(f) One copy to each U.S. Naval Shipyard except Pearl Harbor and Portsmouth Naval Shipyard (total of nine).
(g) Two copies to Pearl Harbor Naval Shipyard (for submarine and surface ship equipment).
(h) Two copies to Portsmouth Naval Shipyard (for submarine equipment only).
(i) One copy to all active submarine tenders (submarine equipment only).
(j) One copy to Submarine Bases, New London and Pearl Harbor (submarine equipment only).
(k) Two copies to Commanding Officer, Ships Parts Control Center, Mechanicsburg, Penn.
(l) One copy to Naval Supply Centers, Norfolk and Oakland.
(m) One copy to Naval Supply Depot, Clearfield, Ogden, Utah.
(n) One copy to Forms and Publications Supply Office, Byron, Georgia.

(c) Manuals for stock shall be in the following quantities:

Number of equipments	Number of copies
1 to 25	25
26 to 99	50
100 and over	100

These manuals shall be shipped to:
Receiving Officer, Naval Supply Depot, Mechanicsburg, Penn.
Marked for COG-I stock.

(d) Copies of approval and procurement record pages in accordance with paragraph 3.10.

3.8 Unless otherwise specified in the contract or order, (where manuals are not to be drawn from stock, see 3.4.1) distribution of all manuals exactly identical to ones previously approved, shall be as follows:

(a) Two copies for each equipment shall be packed with the equipment when the equipment is shipped to ship.
(b) Two copies for each equipment shall be shipped separately to the cognizant Naval supervising activity marked for each ship on which the equipment is to be installed.
(c) Copies of approval and procurement record pages in accordance with 3.10.

3.9 Revisions. - Revision pages shall be distributed to all activities receiving the original manual, and in the same quantity.

3.10 Approval and procurement record page. - This page shall be included in all copies of the manuals and additional copies distributed as follows:

(a) Two copies to Bureau of Ships.
(b) One copy to Forms and Publications Supply Office, Byron, Georgia.
(c) One copy to Ships Parts Control Center, Mechanicsburg, Penn.

3.11 Military Assistance Program Ships. - Unless otherwise specified in the contract or order, distribution of all final manuals for ships being constructed, reactivated, converted or otherwise readied for transfer under the Military Assistance Program (MAP) shall be as follows:

(a) Two copies for each equipment shall be shipped separately to the cognizant Naval supervising activity marked for each ship on which the equipment is to be installed.
(b) Six copies per equipment for each ship to be transferred under MAP to a foreign government. These copies shall be sent to the Military Assistance Advisory Group (MAAG) of the recipient country for delivery to the foreign government which is to receive the ships.
(c) One copy to the Washington, D. C., Naval Attache of the foreign government to receive the ships.
(d) Two copies to the Bureau of Ships.
(e) One copy to the cognizant Supervisor of Shipbuilding when the equipment is to be installed at a private yard.
(f) One copy to the Commanding Officer, U.S. Navy Forms and Publications Supply Office, Byron, Georgia.
(g) Twelve copies to Receiving Officer, U.S. Naval Supply Depot, Mechanicsburg, Penn., marked for CCGE stock.

4. QUALITY ASSURANCE PROVISIONS

4.1 Contractor responsibility. - The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examinations shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Inspection. - Sample copies shall be inspected to determine compliance with the requirements of this specification and for equivalence with the approved (when applicable) sample or basic manual. (If any subsequent manual is not equivalent to or better than an approved class A manual, class A approval may be withdrawn.)

4.3 Content. - The content of the manual shall be checked against the equipment being furnished to assure that it depicts accurately and adequately the equipment and the operating and maintenance procedures required. The NAVSHIPS number on the manual shall be checked for agreement with the NAVSHIPS number on the equipment identification plate where specified.

5. PREPARATION FOR DELIVERY.

5.1 Packaging and packing:

5.1.1 Individual and multi-volume manuals. - Individual copies and multi-volume manuals shall be packed to preclude damage to material. Multi-volume manuals shall be furnished as complete sets.

5.1.2 Manuals shipped with equipment. - When two copies of the manual are packed with the equipment they shall be packed within the shipping container holding the main unit of equipment. The manual(s) shall be so placed that they are readily accessible prior to removing the equipment and shall not be placed within the vaporproof barrier material used to enclose the equipment. Manuals accompanying equipment shall be packaged in a water-proof container. The shipper packing list or bill of lading shall include the NAVSHIPS number of the manual, the quantity and shall indicate which container includes the manuals.

5.1.3 Bulk shipment. - Manuals shipped in bulk shall not be individually wrapped. Containers shall comply with the Uniform Freight Classification Rules or other carrier regulations as applicable to the mode of transportation.

5.2 Marking. - On bulk shipments, interior packages and exterior shipping containers shall be marked with the following information for each item enclosed, except for shipment of an individual copy or an individual set of manuals:

Box (number) of (number) (to be listed on multiple container shipments)
NAVSHIPS number (manual number)
Quantity (in package)

The words "FOR STOCK" shall be entered on the package or packages destined for stock, unless otherwise specified. NAVSHIPS numbers shall be indicated on the shipping documents. When a contract or order requires supplies having different NAVSHIPS manual numbers, the stock copies of each manual number shall be shipped separately.

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6. NOTES

6.1 Ordering data. - Equipment specifications and procurement documents shall specify the following:

(a) Title, number and date of this specification.
(b) Quantity of manuals or ADP pages required, delivery date and delivery destinations (see 6.7 through 6.11 inclusive).

6.2 Classes of manuals. - The class of manual need not be specified in equipment specifications or procurement documents. The intent is that the manufacturer shall supply class A manuals for any equipment for which he has received class A manual approval. He shall supply class B manuals whenever he has not been granted class A approval.

6.2 Use of term "Service Manual". - Manuals to this issue of the specification are identified as "Service Manuals", instead of "Technical Manuals" since past use of the word "Technical" tended to denote a comprehensive, expensive, theoretical and engineering document whereas all that is necessary is a document that provides for satisfactory operation, maintenance and repair.

6.4 Elimination of types. - Previous issues of this specification have established different types for manuals. Types have been eliminated from this issue. The content and make-up of each manual should be tailor-made to delineate the particular operation and maintenance procedures required.

6.5 Rights in data. - Wherever unlimited rights in data are not obtained, the manual should eliminate all proprietary information if operation and maintenance suitability is not thereby reduced. If proprietary information is required to be included and only limited rights in data are obtained, a restrictive clause per ASPR Section 9 should be included on the cover of each manual for ready identification.

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Notice. - When Government drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Preparing activity:
Navy - Ships
(Project 7510-N012R5)

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APPENDIX

10. SCOPE

10.1 This appendix covers the requirements for the production of service manuals.

20. REQUIREMENTS

20.1 Quality. - All manuals furnished will be subject to 35 mm. microfilming. Letters, lines and symbols shall be of a uniform contrast throughout the documents. Blurred or smudged printing or drop out of characters or lines shall be cause for rejection of the publications. Characters shall be no smaller than 8 point type.

20.2 Typography. - Preferred typography is set forth in table I. When revisions are made in the basic manual, the typography shall conform as nearly as possible to the original manual.

Table I - Typography for 8-1/2 x 11 inch manual.

Use	Type style and size	Capitalization	Leading	Spacing between units
Security classification A centered	Gothic 14 pt.	Capitals	6 pt.	
Chapter or section titles	Same type as text	Capitals	6 pt.	48 pt. Following manual copy, text or illustration 18 pt. Preceding text or illustration
Primary side heads	Same type as text	Capitals	2 pt.	6 pt. Preceding or following text
Subordinate side heads	Same type as text	Capitals	2 pt.	6 pt. Preceding or following text
Figure and table titles	Same type as text	Capitals and lower case	2 pt.	6 pt. Following illustration

If 14 pt. is not available, next smaller size shall be permitted.

Table I - Typography for 8-1/2 by 11 inch manual - (cont'd)

Use	Type style and size	Capitalization	Leading	Spacing between units
Notes and cautions	Same type as text	Capitals centered		4 pt. Preceding and following text
Warnings	Same type as text	Capitals centered		4 pt. Preceding and following text
Text, table of contents, list of illustrations etc.	Book face (roman) bold 10 pt.	Capitals and lower case	1 pt.	12 pt. Preceding illustration or following figure title 6 pt Preceding or following notes, cautions, warnings
Keys or legends	Book face (roman) italics 8 pt.	Capitals and lower case	1 pt.	6 pt. Preceding figure title or following illustration
Parts breakdown listings	Book face (roman) 8 pt.	Capitals and lower case	1 pt.	12 pt. Preceding text 6 pt. Preceding bottom rule or following headings
Footnotes	Book face (roman) bold 8 pt.	Capitals and lower case	1 pt.	

NOTES

1. It is not the intent of this appendix to qualify the methods or composing equipment to be used, but to specify results required.
2. Leading and spacing may be relaxed where circumstances require such alterations.
3. The above requirements are for type that will reproduce same size. When oversize pages are used, type shall reduce to approximately these sizes.
4. All type specified may be plus or minus 1 point, except that 8 point type shall be the minimum allowable size.

MIL-HDBK-1690/1D(SHIPS)

NOTES TO TABLE I (cont'd)

6. The type faces listed below are the most preferred. They are available in linotype or can be closely matched on office composing machines.

Book face (Roman)
Garamond
Modern
Bookman
Telbane News
Times Roman
Antique
Baskerville
Century

6. Type sizes as indicated in the requirements were selected for conservation of space and legibility and should not be changed except:

(a) When oversize pages are prepared.
(b) When unusual copy fitting problems arise.

20. Layout.

20.1.1 Text matter. - The preferred layout of 8.1/2 inches by 11 inches text pages is two columns 20 picas wide and 54 picas deep, making an overall page image size of 42 by 60 picas. The text and illustration areas shall conserve space without lessening clarity or legibility. Blanks and spaces shall be avoided, except on fold-ins, and the first major division of the manual (chapter or section) shall be a new odd page.

20.2.2 Fold-ins. - Fold-in pages shall be used only for diagrams, drawings or charts which cannot be reduced for satisfactory presentation on a single page, or when frequent reference is required from other pages of the book. Approx are required. When fold-in pages are used, they should be held to a two-page fold-in whenever practicable and shall not exceed an overall length of 34 inches from the binding edge including the spine. The spine may contain information pertaining to the diagram, drawing or chart.

20

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20.4 Form--punching and drilling. - Service manuals shall be prepared in looseleaf form unless otherwise specified or approved. Looseleaf publications and revisions shall be punched for looseleaf binding with three holes one-fourth inch in diameter and four and one-fourth inches center to center (for 8-1/2 by 11 inch pages) or with such other drilling or punching as specified. Punching of revision pages shall be the same as punching of the original manuals.

20.5 Size. - Suggested sizes for final film of service manuals follow:

4-3/8 by 6-3/4
8-1/2 by 11

All dimensions are in inches.

20.6 Paper stock. -

20.6.1 Text pages. - Paper stock for text pages shall be as specified in 20.6.1.1 or 20.6.1.2.

20.6.1.1 Lithography. - Paper stock shall be white offset book free from unbleached or ground woodchip and shall have a substance weight of not less than 100 pounds per 1,000 sheets; basis 27 by 38 inches.

20.6.1.2 Letterpress. - Paper stock shall be equivalent to white paper-calendered book containing not to exceed 5 percent unbleached chemical wood or ground woodchip, the remainder to be bleached chemical woodpulp, and shall have a substance weight of not less than 80 pounds per 1,000 sheets, basis 25 by 38 inches.

20.6.2 Fold-ins. - Paper stock for fold-in pages shall be equivalent to high wet strength lithographic map, free from unbleached or ground woodchip, and shall have a substance weight of not less than 45 pounds per 1,000 sheets, basis 27 by 38 inches.

20.6.3 Binders. - Binders shall be of plastic or pressboard and shall accommodate looseleaf manuals punched or drilled as specified in 20.4 and shall facilitate insertion of replacement pages. Commercial type fasteners are to be used. Information to be included on the binders shall not be stamped with gold or any other metal foil. Binder colors for unclassified manuals shall be any color except yellow or red. Binders for confidential manuals shall be red. Binders for secret and top secret manuals shall be yellow.

EXHIBIT J

ROBERT J. KRAUS and
MARGARET M.KRAUS, h/w

Plaintiff,

-against-

ALCATEL-LUCENT, ET AL,

Defendants

Index No. 18-2119

EXPERT AFFIDAVIT

ASBESTOS CASE

STATE OF WASHINGTON)
) SS:
COUNTY OF KING)

Arthur W. Faherty, being duly sworn upon his oath deposes and says:

1. I have been employed for many years in the fields of U.S. Navy equipment, and in the applications of U.S. Navy requirements under military specifications, usually referred to as mil specs and the issuances of the Secretary of the Navy and his designees and assignees and subordinates.
2. I am familiar with procedures for both new construction and repair of Navy and commercial vessels.
3. A copy of my CV is attached hereto and incorporated herein by reference as Exhibit A.
4. I have considerable experience in the interpretation of military and Navy documents.
5. I am aware of the Navy specification for the equipment for World War II era ships and later, known as General Specification for Machinery Sub S1-1 page 2.
6. These specifications required warnings and safety precautions.
7. I am aware of the Specifications for Shipyard Contracts.
8. I am familiar with MIL-M-15071, which was the military specification and its successors, including 15071A-C and the specifications referenced in paragraph 5 of that document. MIL-M-15071A-D is roughly the same and involves similar requirements.
9. 15071 states that the intent of the Navy was to accept the usual commercial manuals when roughly equivalent to the overall requirements of Navy.
10. Mil Spec 15071-D was later succeeded by MIL-15071E.
11. 15071D required submission of the manual to the Bureau of Ships which would then adopt the manual as a Navy document.
12. 15071D required manuals to contain safety precautions. (Section 3.1.9)

13. 15071D required that all manuals must contain notes, cautions and warnings to emphasize critical instructions. (Section 3.3.6)
14. Included in 3.3.6 (c) is the definition of the term "warning" which is defined by the Navy as operating procedures and practices which will result in personal injury or loss of life if not correctly followed.
15. 15071D Section 3.1.7 requires instructions to include precautions.
16. I am familiar with the duties of EMO (Electrical Material Officer) and of the ET ratings, seaman through CPO (Chief Petty Officer).
17. Plaintiff served on board the USS Cambria, as EMO from July 1964 to May 1967.
18. I have reviewed the following documents:
    a. 180823 and 190415 Alphabetic list of Cambria Electronic Equipment
    b. Electronics Material Officer Course Information
    c. Electronic Technician 3 Training Course
    d. Maintenance check-off Book for AN/GRC-2
    e. Maintenance Standards for Range-Azimuth Indicator, AN/SPA-4A, RCA, Navships 91825.42
    f. Maintenance Check-Off Book for Indicator Group SPA-8, 8A, 9, Navships 91411.41
    g. Maintenance and Check-Off book for Radio Sets AN/SRC 13, -14, -15, Navships 92441.42
    h. Maintenance Check-Off Book, AN/SRC-10, 10X, 10Y, 11, 11X, 12, 12X, 12Y, and AN/URC-16, 16X, 16Y, 17, 17X, 17Y, 18, 18X, 18Y, Navships 92755.41
    i. Maintenance Check-Off Book, Radio Receiving Sets. AN/SRR-1, 12, 13, Navships 91875.41
    j. Maintenance Check-off Book, Radio Transmitting Sets, AN/SRT-14, -15, -16, Navships 92121.41
    k. Maintenance Check-Off Book, Sonar Sounding Sets, AN/UQN-1B, -1C, Navships 91420.41
    l. Schedule for FRAM Mark II Sea Trial and Material Inspection, USS Cambria, 2 June 1963
    m. Material Inspection, USS Cambria, 20 May 1957
    n. Radio Interference Report, 20/27 July 1963, (date 1 August 1963) USS Cambria
    o. Maintenance Check-Off Book, Radio Transmitting Equipment Navy Model TED Series, Navships 91357.41
    p. (NOTE - All of the above were pages, not complete documents)
    q. Deposition of Robert J Kraus, 27 November 2018, 28 November 2018, 8 January 2019, 9 January 2019 with Exhibits
    r. Exhibit P5, 17 pages
    s. Gossett Notice of Deposition
    t. Landrum Notice of Deposition
    u. Deposition of Roger Gossett, 20 August 2019 with Exhibits
    v. Deposition of Joe R. Landrum, 13 August 2019, with Exhibits
19. Plaintiff Kraus, as EMO, (Officer) was not charged with physically doing work on equipment on board the USS Cambria. Physically working on the equipment was the task of the ETs. (Enlisted)

RWP

20. Plaintiff Kraus, as EMO, was in charge of the Electronic Technicians who worked on the communication and technical (Radar, Sonar, etc.) equipment on board in every location except the engine room.
21. Kraus, as EMO, had to understand the repair issues sufficiently to explain the maintenance/operational/failure issues to the chain of command (senior officers) on the vessel.
22. To accomplish Item # 21, from testimony, Kraus was frequently/constantly/in and out constantly, (verbiage from deposition testimony) around when the electronic equipment was being worked on either in the electronic repair shop or on location of radar repeaters. (The repeaters are the stand that includes the radar screen and electronic controls including capacitors and resistors, for adjustments for the radar screen.)
23. The fan in the electronic repair shop was "always" on, causing air and dust to circulate.
24. From testimony, transmitters, receivers, radios, radars, etc. contained many capacitors and resistors which resulted in high heat.
25. From supplied documentation, US Patents and Navy Specifications and letter, the resistors and capacitors contained asbestos paper for insulation and dielectric properties. (This was prevalent until the late 1960's when Nomex 410 was introduced.)
26. The Navy, in a 5 January 1979 letter to the General Accounting Office noted that asbestos was common in resistors and capacitors on all Navy ships.
27. From testimony, this paper, after use and due to heat, was easily torn, creating dust.
28. Deposition testimony includes opening of radars and antennas.
29. Asbestos gaskets were used on the antenna and radar systems, including SPS-6.
30. Typically the wires used on Navy and commercial ships through the late 1960s contained asbestos in the insulation.
31. Radars have multiple input and output signals that use wiring that terminates in the radar stands.
32. Under conditions of heat, the insulation deteriorates and becomes dusty, and the cooling fans move the resultant dust throughout the radar stands.
33. Testimony of witness shows plaintiff Kraus was close to the equipment with dust, and likely exposed to asbestos dust.
34. I am also familiar with Department of Navy Sec Nav 62603.5 later Sec. NAV 5700.5 dated 1956.
35. This document is also known as Uniform Labeling Program for Hazardous Industrial Chemicals and Materials, hereafter Uniform Labeling Program and was in place when the Plaintiff entered the Navy.
36. The Uniform Labeling Program was designed to standardize labeling requirements for hazardous products and provide labels to contain pertinent information to warn users of potential dangers.
37. The Uniform Labeling Program applied to labeling of all hazardous materials throughout the Navy.
38. The Uniform Labeling Program was not designed to govern the type of warning labels.
39. The Navy stated that the type of labels were to be governed by state and federal laws and regulations.
40. The Uniform Labeling Program noted that development of new products makes it mandatory that precautions should be taken including warning labels. (Section 3)

41. For poisons, a skull and cross bones was to be affixed.
42. Poison is defined as a substance with an inherent property that tends to destroy life or impair health. Asbestos is therefore a poison.
43. Paragraph 1.C of Uniform Labeling Program defines a Class III toxic hazard as any industrial or military material which may be given off a harmful, vapor, dust, fume or mist during handling or operation. The injurious effect may arise from one exposure (acute) or repeated exposures over a prolonged period (chronic). The mode of entry into the body maybe by ingestion, inhalation or absorption through the skins.
44. Paragraph 2.a. of the Uniform Labeling Program refers to the Warning Labeling Guide published by the Manufacturing Chemists Association.
45. This Guide, first published in 1946, requires precautionary labels for harmful dust. The reference to the guide shows the Navy's constant concern for warnings of hazards like asbestos.
46. Thus, by the time Plaintiff began his service in Norfolk in July 1964 the Navy required warnings of the hazards of asbestos in equipment for ships and that all claims that the Navy would have barred or prevented warning labels are untrue.
47. It is clear from these documents that the Navy wanted the warnings to reach Navy personnel on board the vessels and civilian personnel working on Navy ships, such as Plaintiff.
48. The Navy required manufacturers not only to warn on the products but to supply manuals containing warnings to each ship and precautions for use of the product.
49. Thus, when defendants sold products for use on ships that lacked warnings that met state and federal standards and/or the standards of the Manufacturing Chemists or the American Conference of Government and Industrial Hygienists this was in violation of specific Navy directions and requirements.
50. Rather than barring warnings, the Navy encouraged warnings, and the failure to warn of the hazards of asbestos violated Navy requirements.
51. The failure to include warnings and safety precautions in their manuals of their equipment violates specific Navy requirements.
52. The claim that the Navy would have barred warnings is thus false and without basis.
53. The Navy was well aware of the health hazards from asbestos exposure from at least 11 March 1941 and knew of discussions about the health hazards of asbestos exposure since 1939.
54. Asbestos was generally required on all high heat applications.
55. In many cases the suppliers of such equipment usually supplied asbestos product with/on/in their equipment.
56. Suppliers of equipment to the Navy were engaged by the Navy to participate in renovation and overhaul of their own equipment, or that of others, including asbestos containing parts in shipyard repairs.
57. Suppliers of equipment frequently supplied replacement asbestos or disturbed previously supplied asbestos as part of their activities on ships.
58. I expect to testify, at trial, on what the Navy archive records show about equipment supplied to the vessel, or vessels at issue, and what the records show as individual defendants supplying original or replacement asbestos containing equipment or disturbing asbestos.

59. Generally, if a company supplied asbestos with its equipment, some of that asbestos was always present unless the record shows that the asbestos installed by the defendants was entirely removed.
60. The removal of the entire initial asbestos never occurred.
61. I cannot comment, in this affidavit, as to specific defendants whose material I have not yet examined, but will supplement my testimony at trial by reliance on the documents from the archives.
62. From testimony there were no warnings of asbestos in the training manuals for the electronic equipment on the USS Cambria.
63. From testimony, ET's were not aware of asbestos in electronic equipment during their time on board the USS Cambria.
64. From testimony, the USS Cambria underwent an overhaul that included removal and renewal of asbestos insulation on the bulkheads outside the Electronic Shop.
65. I cannot comment, in this affidavit, as to specific defendants whose material I have not yet examined. However, it is clear that asbestos was present in electronic equipment.
66. I am also prepared to discuss the use of asbestos on Navy ships.
67. I reserve the right to amend this affidavit if I am provided more information.

Sworn to and subscribed
Before me this 14th day
of October, 2019

N S BAE
NOTARY PUBLIC
STATE OF WASHINGTON
COMMISSION EXPIRES
APRIL 10, 2022

N S Bae
NOTARY PUBLIC

Arthur W. Faherty
ARTHUR W. FAHERTY

EXHIBIT K

SUPERIOR COURT OF THE STATE OF CALIFORNIA
FOR THE COUNTY OF LOS ANGELES

CHIEF Y.R. BREWER and GALE BREWER,	)	
Plaintiffs,	)	
vs.	)	CASE NO. BC 374988
ALFA LAVAL, et al.,	)	
Defendants.	)	

DEPOSITION OF

SAMUEL A. FORMAN, M.D.

THURSDAY, MAY 1, 2008

DEPOSITION of SAMUEL A. FORMAN, M.D., produced as a witness at the instance of the Plaintiffs and duly sworn, was taken in the above-styled and numbered cause on Thursday, the 1st of May, 2008, from 10:10 a.m. to 2:13 p.m., before Shirley Koch-Smith, CSR No. 10849, RPR, a Certified Shorthand Reporter in and for the State of California, reported stenographically via telephone, pursuant to the California Rules of Civil Procedure and provisions stated on the record or attached hereto.

employing them.

BY MR. WILLICK:

Q. Are you going to testify that the Navy chose not to warn of asbestos?

A. I would offer opinions that the Navy had a sophisticated program depending on controls and for the kinds of workers related to potential airborne asbestos exposure from thermal insulation.

In this time frame the Navy's program did not depend on warning labels on the actual thermal insulation. So to that extent I would offer opinions on how warning labels fit or did not fit into the government and Navy programs in this time frame.

Q. Okay. Now we're starting to venture into stuff that you and I've talked about a couple times and I know you've talked to other attorneys in this firm about and probably every asbestos attorney in the country about.

Have your opinions as to whether or not the Navy required or prohibited warnings regarding asbestos changed since we talked back in -- let me pick one -- we talked back on October 11th, 2000 in the Richard Cunningham case. And by asking you that I'm just trying to ask if I can rely on past depositions for your opinions on this and not explore

it in detail in this deposition.

A. You may rely on past depositions. I believe I've been consistent in my opinions on this topic for -- since 2006 and before so that any deposition or testimony from that time forward would reflect my views from that particular case you mentioned.

Q. Okay. Same question as to your Navy state of the art opinions. As to where the Navy was on the -- on the bell curve of state of the art, early in the game, later in the game, that they were ahead of the curve early on and that they were just with the curve once we get up into the '50s, if I recall correctly. Your general testimony of the Navy state of the art, has that changed since October 11, 2006 when we talked in the Richard Cunningham case? And by asking you that I'm asking the same thing, can I rely on the past depos for that stuff?

A. Yes, you may relay on the past depositions. My general opinions of the naval and government state of the art have not changed in the interim.

Q. Was there any medical monitoring of insulators in the Long Beach Naval Shipyard at the time that Brewer was on the Preble?

A. Yes, there were. And it would have been confined to the groups of workers that the Navy

perceived of as being at risk for asbestosis in that time frame.

Specifically, the civil service insulators and laggers attached to Long Beach Naval Shipyard were included in a yearly physical examination and were extended hazardous duty pay because of the potential asbestos hazard. That said, uniformed sailors who were not working in that trade were not perceived to be at risk and were not included in any special medical surveillance program for asbestos-related diseases.

Q. Okay. Well, do you intend to offer -- what's your opinion why that is? Why the Navy recognized it in the insulators but not in the sailors?

A. In that situation the Navy was continuing in the general observations dating back to the Fleischer/Drinker report that asbestos airborne dust from insulation and lagging work was not, and I'm paraphrasing, that severe of a hazard.

Q. Okay.

A. As a result concern focused in on workers who worked in those trades and was not a very high level of concern. That approach is reflected well in that Pipe Masters Conference from 1957 wherein the leaders of those insulators and laggers reflect a recognition

that the control of airborne asbestos dust and the use of respirators was something less than the Navy's own expectations of its program and that lung disease was occurring, in some cases even to a fatal outcome, amongst the civil service workers.

The Navy perceived of that as a moderate risk that was worthy of more forceful controls. The concentration on that particular kind of worker doing the thermal insulation and lagging full time reflected not only the government and Navy's own approach, but the broad state of the art in that time.

We can see that a few years later, including the time just after Mr. Brewer left the uniformed service, when Dr. Selikoff's information came into the state of the art and the general crest knowledge in the mid to late 1960s that insulators and laggers could be subject to cancerous outcomes independent of the development of scarring disease of the lung. But even then in the mid to late 1960s the interest is focused in on the full-time insulators and laggers.

It was only in subsequent years that concern was appreciated that there was significant hazards to bystanders or to people who had some intermittent exposure to thermal insulation from -- that contained asbestos as a coincidental part of their job.

Q. Okay. Okay.

A. I could go on.

Q. So we -- what we see with Marr is that the information with regard to the -- to the people who are believed to be affected at Long Beach Naval Shipyard, the information did make its way to Marr, and at the Long Beach Naval Shipyard they were doing -- they were taking steps to protect those people whom they recognized a risk?

MR. KING: Objection. Vague.

BY MR. WILLICK:

Q. Is that a fair statement?

A. I would characterize it more specifically in that Lieutenant Marr was part of the Navy industrial hygiene organization ultimately answering to the Navy surgeon general. But at various times he was assigned to the Southern California Navy district, including the Long Beach Naval Shipyard, where he and his organization were charged with making recommendations to the shipyard commanding officers and to the shipboard commanding officers for those ships who were at that station undergoing repairs for incorporation and execution of workplace controls.

Q. And those workplace controls specifically were for the insulation workers, true, and the

laggers?

A. They were focused on the insulation workers. They would have included in this time frame general recommendations on dust control coming down into the training materials of particular Navy trades, for example, machinist mates and boiler technicians. But in this time frame, by and large those recommendations on dust control coming down through the uniformed Navy trades were more of a general dust suppression and would rarely have called out the asbestos potential hazard.

So in answer to your question, I do generally agree with you that in this time frame, the focus of apprised risk and controls was deliberately made by the Navy for its insulators and laggers in the civil service.

Q. Okay. And I heard as part of your answer that during the time that Mr. Brewer was on the Preble, when the Preble came into Long Beach, Long Beach Naval Shipyard had dust controls in place generally for work aboard the vessel?

A. The Long Beach Naval Shipyard had workplace controls in place and carried out to varying degrees focused in on the ripouts of thermal insulation and the insulators and laggers charged with that kind of

work.

Q. When the Preble sailed back out to sea away from the shipyard, were those same controls in place?

A. During --

MR. KING: Objection. Beyond the scope.

THE WITNESS: During this time frame, the sailors encountering thermal insulation coincidental to their work would not have been perceived of as being at risk for asbestos-related diseases. So although there was dust suppression of a general nature included in the trade-related training of machinist mates in that time frame, it would not have been specific to asbestos, nor would it have been executed very vigorously.

Q. So were there, in your opinion, the same dust control measures in place once the Preble sailed out to sea with Brewer on it after it was at Long Beach?

A. Well, I had never served on or visited the USS Preble, certainly not in the time frame that Mr. Brewer was there, so I would be speculating. But in the time frame of the early 1960s, I would expect that dust suppression for asbestos dust for sailors while at sea would not have been very aggressively executed.

Q. All right. Let's attach as next exhibit.

0001

SUPERIOR COURT OF THE STATE OF CALIFORNIA
FOR THE COUNTY OF LOS ANGELES

MELBA LEARN, individually and as Personal Representative of the ESTATE OF ROBERT LEARN; ROBERT T. LEARN; KANDY L LEARN-BONNEMA; DANA M. LEARN; and MARTIN J. LEARN, Plaintiffs, vs. AMERICAN STANDARD, INC. (d/b/a AMERICAN STANDARD PRODUCTS, INC.), et al., Defendants.	Case No. BC330606
TAMARA J. KAPRAUN, et al., Plaintiffs, vs. CRANE CO., INC., et al., Defendants.	Case No. BC332560

TELEPHONIC DEPOSITION OF SAMUEL FORMAN, M.D.
Commencing at 7:06 a.m.
July 14, 2006
San Diego, California

Melanie L. Kirkman, RMR, CRR, CSR 12787

Pages 1 - 129, Inclusive

about the seventh line it says, "This paper mostly utilizes" -- excuse me. "This paper utilizes mostly primary sources to trace the origins of Navy occupational medicine through 1945, ending with the Second World War demobilization. The latter period marked a pause in professional progress, and later activities are both within living memory and have been discussed elsewhere."

You don't believe that there was a reduction in the activities of industrial hygiene and occupational medicine in the United States Navy following World War II?

A. No. Rather, I believe that there was a decrease in interest in the maritime industries and certainly in the size of the contracted shipyards and many of the Navy shipyards itself; however, the legacy of industrial hygiene created and encouraged by the Navy and its consultants like Philip Drinker continued on in the expectation of a formally trained corps of industrial hygiene and occupational medicine officers formally assigned to assignments in each of the naval industrialized commands, and those positions were created and expanded during World War II and remained in place afterwards.

Q. You don't agree that the number of practitioners of industrial hygiene and occupational medicine in the United States Navy was greatly reduced following World War II?

A. I would agree.

Q. Okay.

A. The gross numbers of individuals in uniform in the professions was reduced following World War II; however, there was formally identified billets or places for them which did not exist prior to World War II and remained as a continuing legacy and anchor of the program. There were also expectations on formal training of the professions, both in the service and out of the service, which remained, and the creation of the Medical Service Corps in 1947 included in its numbers industrial hygienists who, at that time, numbered 10 percent of that particular branch of the Navy medical Corps.

Q. And how many industrial hygienists did that represent?

A. I believe there were 111 industrial hygienists and occupational medicine officers trained in the Drinker courses at Harvard and Columbia, plus an additional number of people who

States Navy was aware of the potential for fiber release from a particular piece of equipment; is that correct?

DEFENSE ATTORNEY: Objection. Form. Vague and ambiguous.

THE WITNESS: I cannot recall one off the top of my head, and that was never a specific focus of my research to look into specific brand names and equipment types.

BY MR. GALERSTON:

Q. Well, you looked into generally what the knowledge of the United States Navy was with regard to the potential for the exposure to asbestos; correct?

A. Yes.

Q. And if there were knowledge of the United States Navy that it was aware that there was a potential for exposure to asbestos from a specific piece of equipment, you would expect that you would have seen that in your research, would you not?

A. My approach to the history was predominantly through the medical department encompassing industrial hygiene and occupational medicine and related professions, not so much through the engineering structure in the Navy.

Now, in the course of my research, I did encounter a variety of engineering-related documents, but it was never the primary focus of my research, and --

Q. And you never --

A. -- I do not have opinions on specific-product-related exposure, nor do I recall off the top of my head documents of that sort certainly from the time frame relevant to the Navy service of these individuals.

Q. And I'm not -- I'm not necessarily -- well, strike that.

You never saw any indication that if the United States Navy in some other branch other than the medical branch had become aware of the potential for exposure to asbestos from equipment, that information never made it to the medical branch; is that fair to say?

A. No. The medical branch was charged and is charged by the Secretary of the Navy with providing advice on hazard recognition and controls of all workplace hazards, including asbestos. I'm not aware of a specific documentation addressing that product-specific exposure of the type that you described in the question.

Q. Okay. Likewise, with regards to DeLaval

pumps, turbines, de-aerators, or any other type of equipment, you have never seen any Navy documents indicating that the United States Navy was aware that there was a hazard or risk for exposure to asbestos from working on or around that equipment. Is that fair to say?

A. I have not seen or researched product-specific exposure by any manufacturer.

Q. And that means that you've not seen documents in the possession of the United States Navy that indicates that the United States Navy was aware that there was a potential for exposure to asbestos from DeLaval equipment; correct?

A. I have not researched nor was planning to render any opinion on potential exposure from any branded equipment.

Q. You've not seen any general or specific documentation in the possession of the United States Navy that indicates that the Navy was aware of the risk or the possibility for exposure to asbestos from working on or around DeLaval equipment; is that correct?

A. I do not recall such documentation.

Q. What about working around Crane valves? Have you ever seen any documentation that indicates

and control measures related to dust in general. That typically, in my experience, does not name products.

BY MR. GALERSTON:

Q. Okay. Have you seen any training materials that specifically indicate that a seaman serving aboard a United States Naval vessel could be potentially exposed to asbestos while working on or around equipment?

DEFENSE ATTORNEY: Objection to the form. Vague and overbroad.

THE WITNESS: Could you just restate the question for me, please?

MR. GALERSTON: Melanie, would you read that back, please.

(Record was read.)

THE WITNESS: Yes, I certainly have.

BY MR. GALERSTON:

Q. Okay. What documents do you believe indicate that the United States Navy was aware that the United States seamen could be exposed to asbestos while working on or around equipment on a Navy vessel?

A. Those documents that I have in mind would not be relevant to the time frames of Mr. Krotzer

and Learn's experience because they date more to my experience in uniform and the period immediately prior to that from the 1960, '70s, and '80s. Coming out of World War II, the Navy determined, through studies such as the Fleischer-Drinker study, that asbestos insulation and lagging was not, for all practical purposes, a serious hazard to those individuals working with it as a career trade and, therefore, did not judge it to be a generalized hazard to bystanders or folks occasionally working with asbestos insulation.

Q. The Fleischer-Drinker study that you referred to is a shipyard study; correct?

A. Yes, it was a study of four shipyards, two Maritime Commission yards and two Navy yards.

Q. Okay. And the conclusion was that they did not believe that the risk -- that the risk that is represented by asbestos would not impede United States war efforts; correct?

A. That was not the conclusion.

Q. Okay. How would you state the conclusion?

A. In relationship to the war effort, asbestos was considered a key material to protect the workers from explosion and burn hazards and for

the efficient operation of naval vessels. That is an entire line of discussion that I'll defer to engineers and folks who design, build, and repair ships.

Q. And that was not a -- that was not a conclusion of the Fleischer-Drinker study, was it?

A. No. Fleischer-Drinker focused on potential health hazards for insulation workers and individuals working with lagging and studied workers who had those trades at four different shipyards. We could look at the particular paper, if you'd like. I do not have it in front of me just now, but paraphrasing its conclusion, it concluded that asbestos insulation and lagging work was not, for all practical purposes, a serious hazard.

Q. They didn't say that it didn't cause illness and it did not cause impairment, did they?

A. No, they did not. Rather, the extent of disease they found convinced them that it was not a very serious hazard. It recognized that disease could occur in insulation and laggers -- insulators and laggers but believed that it was not an especially common or a severe hazard.

Q. I believe you indicated and you stated

earlier that the evidence of industrial hygiene/occupational medicine in the United States Navy focused primarily on shipyards and civilian employees until the 1980s, when Lieutenant Brassington was one of the first naval industrial hygienists to be assigned to a ship; correct?

A. I would characterize my views that the Navy has always assumed responsibility for the safety and hygiene, including industrial safety and hygiene, for all of its people, both civil service and in uniform, but that in actual focus of the program, the industrial hygiene program was disproportionately oriented toward the Navy Civil Service workers all the way up until recent times --

Q. Now --

A. -- the '60s and '70s.

Q. Now, Dr. Forman, would you agree with me that the Fleischer-Drinker report that we were just discussing, they -- they got it wrong; they underestimated the hazard and the risk of disease in the shipyard workers; correct?

A. Yes.

Q. Okay. And you would agree with me --

excuse me, I'm going to have to switch phones. My headset is dying on my little battery. Let me hold one second.

Okay. Can you hear me now?

A. Yes, I can. In fact, you're a little clearer than you were before.

Q. Yeah, I had a headset on before.

Fleischer-Drinker underestimated the risk of hazards related to asbestos; correct?

A. Yes.

Q. All right. They underestimated the hazard to shipyard workers, and as such, they completely missed the hazard to servicemen serving aboard World War II and Korean era vessels; correct?

DEFENSE ATTORNEY: Objection to form of the question.

THE WITNESS: I would generally agree with you. Being more specific, in concluding that asbestos insulation and lagging work was not, for all practical purposes, a very serious hazard to those working with it for a career, that resulted in much less interest in people, including both uniformed sailors and civil service people, who would be considered bystanders or not working with the materials constantly.

Volume: I
Pages: 1-65
Exhibits: none

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

IN RE: ASBESTOS PRODUCTS LIABILITY LITIGATION (No. VI) TINA M. WILLIS, Individually and as Personal Representative of the Estate of HIRAM C. PEAVY, Deceased, Plaintiff vs. BW/IP INTERNATIONAL INC., et al., Defendants	Consolidated Under MDL Docket No. 875 EDPA Civil Action No. 2:09-cv-91449-ER Transferor District Court United States District Court for the District of South Carolina, Charleston Division, Civil Action No. 09-02163

TELEPHONE DEPOSITION OF: SAMUEL FORMAN, M.D.
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February 4, 2011

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supplies for packaging. And I just wonder, does that ring a bell?

A. It does not.

Q. Are you familiar with a publication called NAVSUP, N-A-V-S-U-P, Publication 4500 and Consolidated Hazardous Item List or CHIL?

A. I am familiar in general with that program, which had different iterations over a period of years, but in answer to your specific question about that particular document, I can't say that I'm familiar with it off the top of my head.

Q. Insofar as it existed in 1969, are you familiar generally what the Consolidated Hazardous Item List would have covered?

MR. FUSCO: Objection to form. Lacks foundation.

A. I have a general notion that it would have covered materials perceived to be hazardous by the Navy in that time frame. But the specific iteration of that document, I am not familiar with.

Q. Are you familiar with any portion of the Consolidated Hazardous Item List that would prevent a manufacturer from labeling their original container with regard to hazards to life or property from people who might use it?

MR. FUSCO: Objection to form. Vague and ambiguous, lacks foundation.

A. I'm not familiar with the Navy explicitly excluding communications by manufacturers for health issues of the type you're suggesting in that time frame. With respect to that particular document and what its expectations were, I am not familiar with.

Q. Are you familiar with Military Standard 755A?

A. Not by number. Perhaps by topic.

Q. If I told you that the purpose of that military standard is to set forth labels that are to warn users and handlers of potential dangers, does that kind of ring a bell?

A. Well, I'm familiar with the Navy practices about that in that time frame. I'm not familiar with that particular document and its requirements.

Q. Would you agree from your general familiarity with the subject matter that the Navy has military standards that pertain to supplemental labels applied to containers by the Navy as opposed to labels already existing from a manufacturer?

MR. FUSCO: Objection to form. Lacks foundation.

A. I would say that with respect to the military specifications related to labeling and to

specifications more generally, I don't hold myself out to be an expert in that area in any level of detail beyond which a former uniformed Navy officer would know.

I do have an opinion, though, related to the control strategies for asbestos, and that is that the Navy did not use or utilize the labeling program and its related instructions for the control of long-term occupational health hazards, but rather, the control strategies for all kinds of long-term occupational health hazards, including that of airborne asbestos dust from thermal insulation, was pursued by the Navy by other means.

Q. Are you familiar with the Navy and Maritime Commission meeting in 1942 to set forth what would become the minimum requirements for safety and industrial health in contract shipyards?

A. I am.

Q. And you understand that conference that took place in 1942 was chaired by Mr. Daniel Ring and Dr. Philip Drinker?

A. That is my understanding. Yes.

Q. Would you agree that Mr. Ring and Dr. Drinker, in setting up that minimum requirements meeting, stressed that contractor responsibility was an

A. I do not see myself as being expert in the Navy military specification system or particular aspects of its contracting and supply practices, especially as related to a particular manufacturer and product line, so I would say that I don't really have an opinion on that.

Q. Would the same be true if I asked you about Eagle-Picher putting warning labels on its products as early as 1964?

MR. FUSCO: Objection to form.

A. Again, I have no independent research or knowledge of particular companies' practices. My general understanding, as I say, based on secondhand knowledge or hearsay, is that one or another of the thermal insulation manufacturers did start to put health warnings on one or another of their products in the mid-1960s, so what you say is consistent with my general understanding.

Q. Okay. And would it likewise be true that in the mid-1960s, the U.S. Navy did not prohibit those manufacturers that chose to put asbestos warnings on their products from doing so?

MR. FUSCO: Objection to form. Compound, overbroad, lacks foundation.

A. I don't recall the Navy in the mid-1960s

prohibiting thermal insulation manufacturers from placing those kind of labels on material supplied to it during that time frame.

Q. Are you aware -- including the case in which you testified or in addition to that case, are you aware of asbestos manufacturers suing the United States of America for indemnity for asbestos liabilities?

MR. FUSCO: Objection to form. Lacks foundation.

A. Well, the only case that I know of was this one that I was involved in in the 1986, '87 time frame. Not being an expert on the legal history of these questions, I really don't know one way or the other about litigation that would involve asbestos product manufacturers of thermal insulation suing the federal government either as Manville attempted to do in this case that we're discussing or perhaps under other precepts.

So what I'm saying is I don't know.

Q. Okay. And it would be fair to say that apart from your one case that you had personal experience with, you're not aware of allegations in other similar cases or outcomes or just what has taken place between the United States government and the asbestos manufacturers historically?

CERTIFICATE OF SERVICE

The undersigned certify that a true and correct copy of the within Plaintiff's answer to CBS motion for summary judgment has been filed electronically. This document is available for viewing and downloading from the ECF system and was served upon all counsel of record.

Robert E. Paul

Robert E. Paul

Date: January 23, 2020